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FIFTY-FOURTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

NINETEENTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1906.

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State Board of Agriculture, 1907.

Members ex Officio.

His Excellency **CURTIS GUILD, Jr.**
His Honor **EBEN S. DRAPER.**
Hon. **WM. M. OLIN**, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, M.A., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
F. WM. RANE, B. Agr. M.S., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
WILLIAM R. SESSIONS of Springfield,	1908
FRANCIS H. APPLETON of Peabody,	1909
WARREN C. JEWETT of Worcester,	1910

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1909
Barnstable County,	JOHN BURSLEY of West Barnstable,	1910
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1909
Deerfield Valley,	E. P. WILLIAMS of Ashfield (P. O. Buckland),	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1909
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	FRANK GERRETT of Greenfield,	1910
Hampshire,	HENRY E. PAIGE of Amherst,	1910
Hampshire, Franklin and Hampden,	WM. A. BAILEY of Northampton,	1909
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1909
Hoosac Valley,	A. M. STEVENS of Williamstown,	1909
Housatonic,	EDWIN L. BOARDMAN of Sheffield,	1909
Marshfield (Agr'l and Hort'l),	H. A. OAKMAN of North Marshfield,	1909
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1910
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1909
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1909
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1909
Oxford,	WALTER A. LOVETT of Oxford,	1910
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	NOAH SAGENDORPH of Spencer,	1910
Union (Agr'l and Hort'l),	GEORGE O. MILLARD of Blandford,	1910
Weymouth (Agr'l and Ind'l),	QUINCY L. REED[1] of South Weymouth,	1909
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1909
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1910
Worcester South,	C. D. RICHARDSON of West Brookfield,	1910
Worcester County West,	J. HARDING ALLEN of Barre,	1908

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[1] Died April 8, 1907.

THE FIFTY-FOURTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

In presenting my annual report for the year 1906 it would seem not to be out of place to call attention to the remarkable increase in agricultural activity and prosperity, as set forth in the estimates of the Bureau of Statistics of Labor, based on the figures obtained for the State census of 1905. In Bulletin No. 13, issued Oct. 24, 1906, Chas. F. Pidgin, Chief of the Bureau, estimates the value of agricultural products in Massachusetts for 1905 to be $64,000,000. The value of agricultural products ten years earlier, as shown by the census of 1895, was $52,880,431, showing an increase in the last ten years of over 20 per cent. The figures for 1885 were $47,756,033, and a comparison with those for 1895 shows an increase in that decade of 10.73 per cent, or half that of the decade just closed. These figures speak volumes for the gain in material prosperity on the farms of Massachusetts, for the advance in methods and the improvement in business detail attained during the last few years. They show that the farmers of the Commonwealth are not standing still, content with the methods of their fathers, but that, as a class, they are alert and progressive, keeping abreast of the times, specializing as the demands of an ever-varying market call for specialization, introducing new methods in place of those which have served their day, and taking their proper part in the industrial development which has been so marked a feature of the contemporary history of the republic.

In this advance the Board has been an active factor, together with the agricultural societies, the Massachusetts Agricultural College, the Hatch Experiment Station, the grange and the minor organizations interested in the furtherance of agricultural development. All these agencies have worked together with a fair degree of harmony at all times, and to-day there is to be seen a decided tendency on the part of all the separate bodies to draw together and co-operate for the best interests of agriculture, with less of jealousy and more of a spirit of disinterested desire for advancement and upbuilding along agricultural lines.

The work of the Board for the year just closed has been along the usual lines, and, owing to the influences previously noted, has been marked by more features from which genuine pleasure and encouragement can be drawn than has often been the case. The details of the work of the various departments and bureaus of the Board appear in this report under their separate headings. If the Board could have done more, with the means at its command, for the advancement of agriculture during the year, it has simply been that we have failed to grasp our opportunities because of a lack of foresight and shortness of vision, and not because of any lack of energy or desire to do everything useful possible with the means at our command. We shall welcome suggestions for increased usefulness in the future from any source, and stand ready to accept and profit by them in the spirit in which they may be made.

Taken as a whole, the year has been a profitable one for the farmers of Massachusetts, crops generally being good and prices well up to the level required for profit. The corn crop was an unusually valuable one, both as a grain crop and for ensilage. There has not been a year for some time that has been so favorable to the development, curing and harvesting of this crop. The hay crop was unusually heavy in most sections and generally secured in good condition, the second crop being, generally speaking, a heavy one and of good quality. With good crops of hay and corn our farmers came up to the winter with barns and silos well filled with excellent roughage, a condition which is of vast importance for the greater proportion of those depending upon the soil for a livelihood. Dairy products have brought good prices throughout the year, there having been an increase in the prices paid for market milk by the contractors, and butter and butter fat now commanding unusually high prices for the time of year. There seems to be a rather unfair distribution of the increase to the consumers in the price of market milk of 1 cent per quart, the producers receiving less than one-fifth of a cent advance. Where the other four-fifths has gone is a question worthy of investigation by those interested in dairy farming. That there are inevitable losses in the handling of milk by the contractors we must all admit, but that these losses should increase to the amount indicated by the proportion of the advance which they appropriate to their own use, with the advance to the consumer of a cent a quart, does not seem to your secretary as within the bounds of reasonable probability. The old fable of the farmer and the goose that laid the golden egg might be studied with profit to all in certain quarters.

Poultry products brought good prices during the greater part of the year. There has been a shortage of eggs during the fall and early winter on the part of almost all flocks, that cannot but cut into the profits that would otherwise accrue for the year. With the present high prices of grain, continued good prices for eggs and poultry meat are a necessity if the producers are to secure a profit. Market gardeners generally secured good crops and at least average prices. Celery, however, suffered severely from the drought in early fall, and also from blight and rust. The crop was a light one, and is not keeping to the best advantage, so that it is below the usual average for profit. The potato crop, while not a heavy one, was perhaps better than usual, blight and rot being much less prevalent than has been the case in most recent years. Onions were a good crop in eastern sections, but in the Connecticut valley suffered from blight and rot, with light yields and low prices, due to the poor keeping quality of the crop. The apple crop was very light in almost all sections, being a total failure in many places. Peaches were a light crop as a rule, but brought good prices. Cranberries were a good though not an unusually heavy crop. Other fruits and berries generally did well. The year was, however, hardly a successful one for most of our horticulturists.

There is a disposition on the part of some to mourn for the passing of the so-called old New England farmer. The ideal which is in the minds of those who take this view of the situation is that of the man on a small farm, or on a large one partially worked, who kept but a small number of animals, grew but few crops, and did all of his work with the assistance of his family and one man, with at most a little outside help at haying time. This sort of farmer was a common sight fifty years ago, and it is true that he is passing from the face of the earth, but there is nothing to mourn for in this fact. He is giving way to the new New England farmer, — the man who sees that there is a business in agriculture; who follows modern methods; adds to the ancestral acres by purchase, or, where this is impossible, doubles or trebles their productiveness; employs the necessary labor to carry on his increased operations; invests in the best of modern farm machinery, including the gasolene engine or steam or electric power plant; and makes a sufficient profit on each man and machine employed to repay him for the oversight he exercises and the capital invested. Such a man is perhaps not typical of anything except American brains, push and energy, but he is what is, after all, more important than mere idealism, — a success in his chosen calling.

Changes in the Board.

The Board lost one of its most valued members by death during the year, Henry S. Perham, delegate from the Middlesex North Agricultural Society, passing away in Florida, where he had gone in the hope of recruiting his failing health. George W. Trull of Tewksbury was elected to fill the vacancy. Alfred Akerman, M.F., State Forester, resigned during the year, and his place was filled by the appointment of Prof. Frank Wm. Rane, of the New Hampshire College of Agriculture and Mechanic Arts.

Changes in membership resulting from elections by the several societies will be given in the report of the committee on credentials in the proceedings of the annual meeting. Members retiring because of expiration of term of service are: John S. Anderson of the Franklin County Agricultural Society; Johnson Whiting of the Martha's Vineyard Agricultural Society; W. M. Wellington of the Oxford Agricultural Society; H. H. Leach of the Spencer Farmers' and Mechanics' Association; and Albert H. Nye of the Union Agricultural and Horticultural Society.

The Middlesex North Agricultural Society held no fair and is not eligible to draw bounty. It will therefore lose its membership in the Board, and George W. Trull retires from the Board for that reason.

Meetings of the Board.

On July 24, 1906, the Board held the most successful summer meeting since the inauguration of this popular feature of its work, at Whalom Park, Fitchburg, with demonstrations of practical problems of interest to farmers as the main feature of the meeting. The attendance was the largest ever gathered at a meeting of the Board of any kind, and probably the largest ever present at an agricultural meeting in the State, if we except the fairs of the agricultural societies. It was generally estimated by the press at 2,000, but this is probably excessive. A conservative estimate of those in attendance at the demonstrations would be about 1,200, more rather than less, but there were many others on the grounds.

Prof. F. S. Cooley of the Massachusetts Agricultural College demonstrated the points of the dairy cow, scoring an animal before him on the platform. Mr. Henry M. Howard of West Newton illustrated the proper methods of planting, setting and caring for market-garden crops, particularly lettuce, celery and cauliflower, to the great satisfaction of the audience. Next came a demonstration of the proper methods of packing apples for domestic and foreign markets, by Hon. W. H. Blodget of Worcester, assisted by Mr. Wm. P. Thayer. This important subject was thoroughly explained and illustrated, and the farmers present were much pleased with the demonstration. The last demonstration of the meeting was of the killing and preparation of fowls for market, by Mr. W. D. Rudd of South Natick. Mr. Rudd has had years of experience in both the producing and the sale end of the market poultry business, and is particularly well qualified to explain the proper preparation of poultry for the Boston market. His running lecture on this and other phases of poultry raising was very practical and instructive. These demonstrations were held in the magnificent out-door theatre at the park, the use of which was donated by the management. The large and well-lighted stage and the excellent arrangement of the seats in the sloping auditorium gave every one an excellent opportunity to see and hear.

The demonstrations were followed by an excellent dinner in the open-air dining room, furnished by the caterer at the park. Nearly five hundred people sat down to dinner, and probably twice as many more availed themselves of the opportunity to enjoy the basket lunches which they brought with them. After dinner the principal address was delivered by Governor C. J. Bell of Vermont, on the advantages of country life. Other speakers were Lieutenant-Governor Eben S. Draper, President Kenyon L. Butterfield of the Massachusetts Agricultural College, and members of the Board. Following the speaking many of those present visited the dairy farm of Mr. George N. Proctor, situated within a few minutes' walk of the park. The meeting at Fitchburg is likely to remain for some time a model to be imitated, but it is not probable that it will be soon excelled.

The public winter meeting for lectures and discussions was held at Springfield, at the invitation of the Springfield Board of Trade. The addresses and discussions were fully up to the high level of excellence set by the meetings of previous years, and from the standpoint of valuable matter, to be later included in the annual report of the Board, the meeting was a great success. The attendance, however, was considerably below what it should have been, and this in spite of the central location and good railroad and trolley connections, to say nothing of the pains that had been taken in advertising the meeting. The weather was not especially favorable, being very cold the first day and rainy on the third, but nevertheless the attendance was a disappointment. A pleasing feature of the meeting was a banquet arranged by the Board of Trade. Governor Guild had promised to be in attendance, but was obliged to cancel the engagement, and Lieutenant-Governor Draper substituted as the guest of honor, to the satisfaction of all. The lectures and discussions of the meeting will be found printed elsewhere in this volume.

The annual business meeting of the Board was held at Boston, Jan. 8 and 9, 1907, and special business meetings were held at the summer and winter meetings. The minutes of these meetings, with reports of committees, will be included in this volume.

Agricultural Societies.

The agricultural societies were for the most part favored with pleasant weather for their annual exhibitions, with the result that they were more successful financially than is often the case, in some cases unusually so. The attendance, judging from the reports of the inspectors, seems to have been large, and with the usual proportion of interest in the agricultural side of the fairs. From an educational standpoint the quality of the exhibits seems to be steadily improving. One society, the Middlesex North Agricultural Society, held no fair during the year, and in consequence loses its right to bounty and to representation on the Board. This is to be regretted, as it leaves the northern part of Middlesex County, the second county in the State in area and value of agricultural products, without a society holding exhibitions. We trust that they will find a way out of their difficulties which will allow them to recommence operations.

For the past three years I have recommended that the societies establish sinking funds to tide them over years of bad weather, and also give their premium lists a careful overhauling, nor have I seen anything during the past year to weaken my conviction of the wisdom of the course. At their fairs this year two of the largest agricultural societies in the State cut down the number of breeds of cattle to which they paid premiums, one going so far as to pay premiums for but four breeds. In both cases the premiums paid to the breeds exhibited were increased, and the result was, especially in the case of the society giving premiums for but four breeds, that the exhibit was greatly improved. In fact, I can say without hesitation that the exhibition of cattle at this fair was the very finest that I have ever seen at a fair in New England. While possibly many of the societies would hesitate to adopt such a course, and in some instances might not be justified in so doing, owing to the mixed character of the cattle kept in their territory, there is no question but that in almost every instance the same principle could be applied to poultry, with profit to the society and to the *bona fide* breeders and exhibitors of the locality. Under the "any other variety" clause there are a number of men going from fair to fair with strings of birds, many of them of no particular excellence, taking premiums from the society's coffers without any return in the way of an exhibit of an educational character.

Last year I called the attention of the societies to the question as to whether many of the so-called attractions engaged by the fairs really attract, or whether they are not a drag upon the financial success of the fair, rather than an aid to it. Where an attraction is engaged, it must draw enough people to the fair, who would not otherwise attend, to pay for itself, or else it is a failure in its capacity as an attraction. There are ten or twelve societies in the State that do without attractions, or at least they expend but small sums for that purpose. Their financial success, taken year in and year out, is generally better than that of the societies that adopt the opposite course. While their accounts for the year may not be as imposing in round figures, their balance is oftener on the side of profit. The real purpose of the fairs of the agricultural societies is to bring about the advancement of agriculture by educational exhibits, and, if that is accomplished without loss to the society, it may well leave the vaudeville out. Very often the fairs expending the most money for attractions have excellent agricultural exhibits, which are enjoyed by their discriminating patrons; and it is from the standpoint of business, and not in a spirit of criticism, that I offer these suggestions.

Farmers' Institutes.

The institute work has been very successful and satisfactory during the year. Practically the same number of meetings have been held as in 1905, with a slight increase in attendance. Three circuits of institutes were held, with Prof. John Craig of Cornell University, Prof. Chas. D. Woods of the Maine Agricultural Experiment Station, and Dr. Geo. M. Twitchell, as speakers. These meetings were very satisfactory, as they gave the farmers of Massachusetts an opportunity to hear speakers from a distance, of more than usual reputation in the institute field, and without increased expense to the State. This year we shall repeat the arranging of these circuits, and hope to have Prof. Thomas Shaw of Cornell University, Dr. Geo. M. Twitchell of Maine, and Prof. C. L. Beach and Prof. L. R. Jones of Vermont, as speakers.

One hundred and twenty-six meetings have been held during the year, with 155 sessions. All the societies represented on the Board have held 3 or more institutes, except the Spencer Farmers' and Mechanics' Association and the Nantucket Agricultural Society, which held but 2 meetings, and the Massachusetts Society for Promoting Agriculture, which is represented on the Board by special act, and holds no institutes. Eight societies held 4 or more meetings. Eighteen other meetings have been held in sections not entirely covered by societies represented on the Board, where the demand for institute work appeared to warrant the holding of such meetings. The average attendance for the year has been the largest since records of attendance have been kept, being 127 per session, as against 125 last year, 109 for 1904, 102 for 1903, 104 for 1902, 107 for 1901, 91 for 1900 and 94 for 1899. The total attendance for the 155 sessions was 19,727, also the largest on record. At two of these sessions the attendance was 400 or more; at 11, from

300 to 399; at 15, from 200 to 299; at 50, from 100 to 199; at 45, from 50 to 99; and at 27 it was less than 50.

If the institute work is to continue to progress and to take on new features in the way of demonstrations, new speakers from a distance, etc., an increased appropriation will be a necessity within a very few years. Our present appropriation of $3,000 for the dissemination of useful information in agriculture is barely sufficient for present needs, and will not admit of expansion and improvement. But a portion of this appropriation is devoted to institutes, and the other lines of work are also constantly broadening and expanding. I would call this matter to the attention of the Board, and ask for careful consideration on the part of the members as to whether an increased appropriation is not likely to be a necessity for the present year.

On Nov. 12 and 13, 1906, your secretary attended the annual meeting of the National Association of Farmers' Institute Workers, at Baton Rouge, La., and read a paper upon "How the institutes can interest the city or town dweller in rural life." The meeting was a very successful one, and was well attended by those at the head of the institute work in the various States. A comparison of the reports submitted at the meeting as to the work in the various States shows that Massachusetts is in the front rank in total number of meetings and in attendance per session, and, further, that we make an even more favorable showing in the way of attendance per dollar of money expended, being surpassed in this respect by but three States. On the following two days I attended the annual meeting of the Association of Agricultural Colleges and Experiment Stations, as a delegate from the Board of Trustees of the Massachusetts Agricultural College.

Better Farming Special Train.

The "better farming special train" is a western idea, brought to New England with excellent results. The credit for the commencement of agitation on the subject lies with the "New England Homestead," which took the matter up last winter and pushed it to a successful conclusion. The train, which toured the States of Massachusetts, New Hampshire and Vermont, consisted of an engine and four passenger coaches, furnished by the Boston & Maine Railroad without expense to any of the organizations interested for either the train or the train crew. Three of these cars were fitted up with exhibits illustrative of new and improved methods in agriculture, furnished mainly by the Massachusetts Agricultural College and the Hatch Experiment Station. One car was devoted to "Farm crops and fertilizers," another to "Animal husbandry and dairying," and the third to "Horticulture and insect pests." Each car bore a large sign on its sides, showing what it contained, and the fourth car, used mainly for purposes of conveyance for speakers and others, was labelled "Better farming special train." This train started from Amherst on the afternoon of April 3, after a trial lecture to a large crowd assembled at that station, and for the four succeeding days toured the various divisions of the Boston & Maine system, beginning at Mount Hermon on the morning of the 4th and finishing at Haverhill on the afternoon of the 7th. Great interest was everywhere shown in the project and in the exhibits and talks and explanations by the members of the college and station staffs who accompanied the train. The usual procedure when the train arrived at a station was for your secretary to make a brief announcement of the purposes of the train and the contents of the various cars, and advising the crowd to break up and enter the cars, where the matters in which they individually felt the most interest were to be seen. About forty minutes were then devoted to explanations and running lectures in the various cars, and then the train would be emptied and move on to the next stop.

Altogether, the project was a great success, and I trust that it may be continued for another year at least. This Board was unable to lend as much financial assistance to the train as we could have wished, owing to urgent calls in other directions. If we can secure an increase in the appropriation for "dissemination," a portion of that increase may well be devoted to this very laudable object.

NURSERY INSPECTION.

The work of nursery inspection has been efficiently administered during the year, and there is at present but little danger that infested stock will come into the hands of our orchardists from Massachusetts nurseries. The San José scale has, however, become a menace to our orchard interests, which is at present more pressing, when the State as a whole and fruit trees in particular are considered, than that from the gypsy and brown-tail moths. In many sections of the State orchards and more especially small collections of fruit trees about city and town residences have become generally infested by the scale. Where all unite in fighting the pest, it can at the worst be held in check ; but many owners simply neglect their trees, leaving them to die from the ravages of the scale, and in this way forming a standing menace to their neighbors. Where one man takes care of his trees and his neighbors refuse to do so, it is inevitable that the trees of the careful man will become reinfested by the scale, which is brought on the feet of birds and by other agencies, so that, fight as hard as he may to preserve his property, he will eventually be driven to let his trees go the way of his careless neighbor's. The Nursery Inspector will submit to you certain proposed remedies for this state of affairs, whereby he shall have power to declare the scale a nuisance, and compel private owners to eradicate it from their property as nursery men are now compelled to do. I would recommend that this Board take the necessary steps to place itself on record on this matter, and to assist in every way in securing such legislation. I would further advocate a strict quarantine law, providing for the inspection of all trees or plants coming into the State from other States or from foreign countries.

DAIRY BUREAU.

The management of the Dairy Bureau has been continued during the eleven months of the fiscal year along the economical and efficient lines heretofore carried out. There have been more inspections during the eleven months than in any similar period in the history of the Bureau; while, on the other hand, the number of cases which could be brought to the attention of the courts is less than for some years. The trade in colored oleomargarine appears to have nearly reached the vanishing point, being confined to peddlers, while that in the uncolored goods appears to be decreasing. The grocers and others handling renovated butter seem to have come for the most part to the conclusion that honesty is the best policy, and conduct their business with more regard for the law on the subject than ever before. The details of the work of the year appear in the report of the general agent, Mr. P. M. Harwood, which is included in this volume. The educational work of the year shows an increase in the number of meetings held and in the interest of those in attendance at them. Your secretary has nothing but praise for the work of this department.

Cattle Bureau.

The report of the Chief of the Cattle Bureau will be found printed elsewhere. Not having oversight of the work of this Bureau, and not being particularly conversant with it, I would refer you to that report without comment.

State Forester.

Alfred Akerman, formerly State Forester, resigned, to accept a position in his native State, and the vacancy thus caused was filled by the appointment of Prof. F. W. Rane of the New Hampshire College of Agriculture and Mechanic Arts. Professor Rane has had charge of the horticultural and forestry interests at that institution for some years, and brings to his work in Massachusetts a fine knowledge of conditions in New England woodlands and a most commendable enthusiasm. I had the pleasure of recommending his appointment to Governor Guild, and feel assured that he will work in harmony with this Board at all times. Nevertheless, I still feel that it is to be regretted that the State Forester and his department do not form a part of the machinery of this Board.

Massachusetts Agricultural College.

This institution, the farmer's college of Massachusetts, and the child, in a sense, of this Board, has made a steady and gratifying advance during the year. The total attendance at the college is the largest that it has been in the history of the institution, and there appears to be every prospect that there will be continued increase for several years to come. To care for the students who are coming to the college an increased equipment and teaching force is required. It is doubtful if more students than are at present in attendance can be cared for satisfactorily with the present equipment. In the nature of the work at the college, classes or sections of classes cannot be large and still receive proper instruction. I trust that the Legislature will see the necessity for increased equipment, and make the necessary appropriations for that purpose. A new set of greenhouses is among the imperative necessities of the institution. Those now on the grounds have been in use for forty years, and it is absurd to suppose that proper instruction in greenhouse work, which is one of the principal specialties of Massachusetts, can be carried on with an antiquated equipment. The appropriation of last year was insufficient to complete the botanical building, and an additional appropriation must be asked for that purpose. There are many other improvements needed at the college, and I would recommend that this Board place itself on record as favoring every appropriation asked for that will tend to the increased efficiency of the institution as an educational institution.

The experiment station will soon be in receipt of increased funds under the Adams act, and will be in a position to continue and amplify its very efficient work.

The Gypsy and Brown-tail Moths.

The work against these insects has continued during the year under the direction of the State superintendent, A. H. Kirkland, M.S., and along the lines laid down in the act establishing the work in 1905. I am confident that the work is being carried on in the best possible manner, with conditions as they are under the present plan of suppression.

It is to be regretted that owing to the lapse of the work suppression and not extermination must now be the aim; but that was inevitable, and is now past history. I note with pleasure that the agitation for national aid, commenced by this Board many years ago, has at last borne fruit in the shape of an appropriation of $82,500 for the suppression of the moths in New England. This appropriation will undoubtedly be renewed and perhaps increased for 1907. One pleasing feature of this matter is the hearty aid in securing this appropriation given by certain former opponents of the work. The report of the committee on gypsy moth, insects and birds will be submitted to you. I have nothing of especial importance to add to that report.

Crop Reports.

The publication of monthly crop reports has been carried on as in former years. The special articles included in these reports were: "The home garden," by Prof. F. W. Rane; "Some causes affecting the profits of dairying," by Prof. F. S. Cooley; "Clovers: their value, characteristics of varieties and methods of production," by Prof. Wm. P. Brooks; "Some practical phases of poultry feeding," by John H. Robinson; "Cranberry culture," by Lucian J. Fosdick; and "Peach culture," by Prof. F. A. Waugh. Calls came in in such numbers for the report containing the article on the home garden that the extra supply was exhausted almost at once, while our supply of those containing the articles on clovers and poultry feeding have been exhausted for some time, and we have but few of the bulletins on cranberry culture on hand. The edition was further increased during the year, from 4,300 in May to 4,700 in September and October. Increased editions mean of course increased expense, and here we find another argument for an increase in our appropriation for "dissemination."

Nature Leaflets.

But one new leaflet was issued during the year 1906, viz., No. 33, on "Three common scale insects," by Dr. H. T. Fernald. This leaflet contains information on the San José scale, and has been found very useful.

Second editions of leaflets Nos. 3, 5, 18 and 27 have also been issued, in order that sets might be supplied on application.

EXTRACTS FROM THE TRESPASS LAWS.

Statistics show a greatly increased demand for the trespass extracts, the number of individual applications exceeding those of 1905 by 240, and the number of copies sent exceeding those of 1905 by 1,234.

The following table contrasts the number of individuals requesting extracts, the number sent, and the variations from month to month, during the years 1905 and 1906: —

MONTH.	APPLICATIONS.		COPIES SENT.	
	1905.	1906.	1905.	1906.
January,	5	27	17	124
February,	4	23	17	108
March,	19	46	84[1]	225[1]
April,	78	99	370	490
May,	76	117	358	555
June,	54	64	253	314
July,	53	95	254	467
August,	63	72	292	352
September,	43	61	201	285
October,	45	73	210	343
November,	25	27	113	135
December,	13	14	65	70
Totals,	478	718	2,234	3,468

[1] In 1905 post-offices were supplied with 950 copies for posting, as provided by law, and in 1906 with 879.

It appears, therefore, that the trespass nuisance is greatest in the months of April and May, and that it is also serious in the months of June, July, August and October. Presumably most of the trespassers can be included under hunters, fishermen, flower and berry pickers and nut gatherers. It is noted, however, that some requests for trespass extracts indicate that trespassers have even taken growing trees, stone walls, cord wood, etc. It is believed that the trespass extracts posted throughout the Commonwealth act as a deterrent, and therefore serve a good purpose.

PUBLICATIONS.

The following publications were issued by this office in 1906, most of which may be obtained on application : —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1905, .	758 [1]	15,000	July 10.
Arbor Day, 1906, ...	32	2,500	April 20.
Schedule of Duties of Inspectors to Fairs,	8	200	May 3.
Crop Report No. 1, ...	40	4,300	June 11.
Crop Report No. 2, ...	40	4,500	July 5.
Crop Report No. 3, ...	40	4,500	Aug. 2.
Crop Report No. 4, ...	40	4,600	Sept. 5.
Crop Report No. 5, ...	40	4,700	Oct. 10.
Crop Report No. 6, ...	40	4,700	Nov. 8.
Nature Leaflet No. 3 (reprint), . .	4	1,000	May 21.
Nature Leaflet No. 5 (reprint), . .	4	1,000	May 21.
Nature Leaflet No. 18 (reprint), .	4	1,000	Nov. 19.
Nature Leaflet No. 27 (reprint), .	4	1,000	Nov. 19.
Nature Leaflet No. 33, . . .	6	1,000	May 21.

[1] Including eighteenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 254 pages.

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1905: "Market gardening," by Mr. Henry M. Howard; "Education and industry," by Dr. W. E. Stone; "Bush-fruits," by Prof. Fred W. Card; "The management of mowings," by Prof. Wm. P. Brooks; "Practical poultry housing," by Mr. John H. Robinson; "Commercial pork making and pig raising in New England," by Mr. A. A. Southwick; "Clean milk: suggestions for the average producer," by Mr. P. M. Harwood; also the annual reports of the Chief of the Cattle Bureau, the Dairy Bureau, and the State Nursery Inspector.

LEGISLATION.

The only legislation of 1906 having reference to the Board of Agriculture or to the agricultural societies was the usual appropriation bills: "An Act making an appropriation for exterminating contagious diseases among horses, cattle and other animals" (chapter 46); and "An Act making appropriations for salaries and expenses in the office of the State Board of Agriculture, and for sundry agricultural expenses" (chapter 60).

LEGISLATIVE APPROPRIATIONS: BOARD OF AGRICULTURE.

OBJECTS FOR WHICH APPROPRIATED.	1906.[1]		1907.[2]
	Appropriated.	Used.	Appropriated.
Bounties to societies,	$18,600 00	$17,578 38	$18,600 00
Salaries of secretary and clerks,	5,683 33	5,683 33	6,200 00
Travelling and necessary expenses of Board,	1,200 00	849 60	1,500 00
Lectures before the Board, etc.,	100 00	99 02	700 00
Dissemination of useful information in agriculture,	2,750 00	2,716 62	3,000 00
Travelling and necessary expenses of the secretary,	450 00	317 53	500 00
Incidental and contingent expenses, including printing and furnishing extracts from the trespass laws,	900 00	840 72	1,100 00
Printing 15,000 copies of "Agriculture of Massachusetts,"	5,800 00	5,308 30	5,800 00
Work of the Dairy Bureau, including salaries,	7,699 99	7,699 99	8,800 00
State nursery inspection,	1,000 00	998 23	2,000 00
Special report on the birds of the Commonwealth,	2,727 50[3]	267 69	3,993 11[4]
Totals,	$46,910 82	$42,359 41	$52,193 11

[1] For eleven months, ending Nov. 30, 1906.

[2] For year ending Nov. 30, 1907.

[3] Unexpended balance.

[4] Including unexpended balance of $2,459.81.

The Legislature of 1906 also appropriated $60,000 to be expended under the direction of the Chief of the Cattle Bureau of the State Board of Agriculture for exterminating contagious diseases among horses, cattle and other animals; also, $13,291.66 for salaries and expenses connected with the office of the Cattle Bureau, and $6,416.66 for salaries and expenses connected with the office of the State Forester.[1]

Arbor Day Pamphlet.

Arbor Day in Massachusetts was established by chapter 32 of the Resolves of 1886, in which His Excellency was requested to set apart in each year the last Saturday in April as Arbor Day, and to issue an appropriate proclamation. This provision has been complied with annually, but the day has not been observed in this Commonwealth to an extent as great as in several of the other States.

In April last, largely because of an expressed desire on the part of the forestry department of the State Federation of Women's Clubs that a pamphlet in the interests of Arbor Day might be published under State auspices, this office, in co-operation with the State Board of Education, issued "Arbor Day, 1906." Prior to this the only printed matter on the subject issued by the State were two 8-page "Circulars for Arbor Day," issued by the State Board of Education in 1892 and 1893 for use in the public schools.

Twenty-five hundred copies of "Arbor Day, 1906," a 32-page illustrated pamphlet with cover, were printed and sent largely to superintendents of schools for the use primarily of teachers of nature study and the natural sciences in our public schools. It was hoped that the effort would result in bringing about more observance of the day both on the part of teacher and pupil, and that they might become more impressed with the value of our common trees, flowers and birds.

The pamphlet contained Governor Guild's proclamation; a paper on "Arbor Day," by Mrs. Cora C. Stuart Jones, chairman, department of forestry, State Federation of Women's Clubs; a paper on "Arbor Day in the schools," by Hon. George H. Martin, secretary, State Board of Education; a paper on "The selection and care of ornamental trees, shrubs and vines for school yards and roadsides," by Prof. Samuel T. Maynard, a well-known horticultural expert; a paper on "How birds care for trees," by Mr. Edward H. Forbush, ornithologist to the State Board of Agriculture; a paper on "The gypsy and brown-tail moths," by A. H. Kirkland, M.S., State Superintendent for the Suppression of the Gypsy and Brown-tail Moths; extracts from a statement concerning "School gardens in Massachusetts," by Dr. B. T. Galloway of the United States Department of Agriculture; and several pages of "Information — selections — suggestions," compiled by Mrs. Ada M. Stiles of the forestry department of the State Federation of Women's Clubs. The cover design was drawn by Mr. Forbush.

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[1] For eleven months, ending Nov. 30, 1906.

Requests for the pamphlet have come from long distances, even as far as Colorado and Montana, and it is believed that much good has been done. The desire has been expressed that this publication be made an annual one.

Press Bulletins.

These abstracts of bulletins and other publications have been issued as usual during the year, and, judging from the calls that we have received for the publications mentioned, it would seem that they must have been given their fair share of space by the press of the State. I wish to thank the press for the kind treatment they have accorded us in this matter, and to assure them that the bulletins will be continued as long as they can find space for them. We have also made use of this means for advertising the various meetings of the Board, with excellent results.

Codification and Amendment of Laws.

The committee appointed at the last annual meeting of the Board to consider my recommendations in this regard in my annual report for 1905 met at this office, and gave the question thorough consideration. Its final conclusion was, that, owing to conditions existing and in view of all the facts at hand, it was not wise to press for a thorough revision of the laws relating to agriculture and the agricultural societies at this session of the Legislature. I would, however, recommend that this committee be continued, with power to act, and that the further consideration of this problem be taken up during the year.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

Boston, Jan. 8, 1907.

SUMMARY OF CROP CONDITIONS, 1906.

The weather of May was cold but pleasant, with frosts on the mornings of the 20th and 21st, which did considerable damage to early vegetables. Pastures and mowings wintered very well, but owing to cold weather grass started slowly, and later its growth was checked by drought. There was a good bloom of apples, but pears, plums, cherries and peaches showed a rather light bloom. Small fruits and berries generally bloomed full. Little damage from frost was reported. Few insects appeared, and did little damage. Planting was somewhat backward, due largely to the late opening of the season and cold weather. Farm help was unusually scarce; average wages, $20 per month with board, and $1.50 per day without board. There was a slight increase in the acreage of corn, potatoes, tobacco and onions, and a new cranberry bog was reported as being made.

Insects were unusually prevalent in June, but not doing excessive damage. Indian corn was late, but of good stand and color. Haying had hardly begun at the close of the month, and a good crop was generally expected. The acreage of forage crops showed no special increase. Early potatoes were somewhat later than usual, but looking well. Early market-garden crops were later than usual, with prices higher than for some years. The flow of milk was well maintained, but prices for butter and butter fat were lower than the year previous. Dairy cows were in fairly good supply, with easier prices. Pastures were in first class condition. Strawberries were a good crop; cherries light; plums and pears promised to be light; peaches fairly good; apples promised well.

Potato bugs were reported as more numerous than usual in July, and harder to keep in subjection. Indian corn was a little backward, but making luxuriant growth. Haying was not completed, but the crop was considerably above the average. The acreage of forage crops was not increased, and all were in excellent condition. Market garden-crops were yielding well, with prices a little above normal. Potatoes promised well, though few had been dug. Apples promised only a light crop ; pears and plums light ; peaches fair in most sections ; quinces good ; grapes and cranberries promised well. Pastures were green and growing, with abundant feed. Oats rusted badly ; rye good ; barley grown only for forage.

Indian corn came forward rapidly during August, and promised a very fine crop. Sweet corn is extensively grown in eastern sections for the market, and in all sections as a late forage crop. Rowen promised to be an unusually heavy crop. Late potatoes were generally suffering from blight. There was a slight increase in the acreage of tobacco, and an excellent crop. Pastures were in unusually good condition. Apples promised only a very small crop ; pears also light ; peaches light, but better than usual ; grapes set unusually full, and developing well ; cranberries promised a very good crop. Oats were a heavy crop, though suffering from rust ; barley good as a late forage crop.

At the close of September the corn crop appeared to be a bumper one, and to have been secured practically without damage from frost or rain. The rowen crop was a little above the normal in general, and in the main was secured in good condition. Feed in pastures suffered from drought. Much less than the usual amount of fall seeding was done, owing to dry whether, and that put in came forward very slowly. Onions were considerably less than a normal crop, having blighted badly. Potatoes gave a better crop than was expected, but still considerably below the normal. Root crops suffered somewhat from drought, and celery suffered severely from the same cause. Late market-garden crops generally promised light yields. Apples dropped badly, and the crop promised to be very light ; pears a fair crop ; peaches did not yield as well as was expected ; grapes showed considerable rot and mildew ; cranberries promised a good average crop, generally secured in good condition.

The final report of the season, at the end of October, showed a corn crop considerably above the normal in value, both for grain and stover. The warm, dry weather at and after harvesting time was especially favorable to the ripening and securing of the crop. Where the crop was used for the silo it was secured in prime condition, with no damage from frost. Root crops were a little below the average, owing to drought during the latter part of August and the first of September. Where raised for market they generally brought good prices. A fair crop of potatoes was secured in most sections, with good prices prevailing to date of making returns. Pastures held out well throughout the year, and stock went to the barns in good flesh and health, both milch cows and dry stock. Considerably less fall seeding than usual, owing to dry weather; that put in early was generally reported as doing well, though backward. Prices for crops raised for market, as indicated by the returns, ranged higher than in former years, and this was the more remarkable as there were no shortages in the principal crops, with the exception of apples and onions. Of 129 correspondents answering the question as to prices, 11 spoke of prices as lower than usual, 74 as average or about average, and 44 as higher than usual.

Concerning the questions as to "most profitable crops" and "least profitable crops," 64 correspondents, less than a majority, considered hay to have been among the most profitable crops; 51, corn; 24, potatoes; 11, tobacco; 8, apples; 8, tomatoes; 7, cranberries; and 6, sweet corn; while 66 correspondents reported potatoes to have been among the least profitable crops; 24, apples; 17, onions; 11, cabbages; and 4, corn.

The season of 1906 appears to have generally been a profitable one for our farmers. In the main, good crops were secured, while prices, as above noted, ruled high. Of the 138 correspondents answering the question as to profits, 85 considered the season to have been a profitable one, 21 an average season for profit, 11 that it was fairly profitable, while 12 thought it was above the average for profit and 9 that it had not been a profitable one.

Massachusetts Weather, 1906.

[Compiled from Data furnished by the New England Weather Service.]

The weather of January was generally unseasonable, with few storms and high temperatures throughout the month. The mild weather caused buds to start, and ice disappeared on streams. The greater part of the precipitation occurred as rain, and was fairly well distributed over the month. The snowfall was light, and at the close of the month there was little on the ground.

February weather was less severe than the normal. On the 9th there was a general and quite heavy snowfall, except on the immediate coast, where rain fell. The month closed with a storm of moderate energy, both rain and snow fell, followed by a decided fall in temperature, with high winds and gales.

March was unseasonably cold as a whole, the temperature ranging at or near zero to an unusually late date. The snowfall was greatly in excess of the March average, generally exceeding the fall of the preceding three months. After the 26th the temperature was decidedly higher, and the snow rapidly disappeared, with rain on the closing days of the month.

April was a seasonable month, no marked departures from the normals occurring in any of the elements. The precipitation was well distributed through the period and over the State. The month as a whole was pleasant, and the season near the average at its close.

May was characterized with much pleasant weather, there being an average of thirteen clear days, eleven days when the sky was partially obscured, and but ten days without sunshine. The total rainfall was, however, considerably in excess of the normal, more than half the monthly amount occurring in the storm of the 27th and 28th. The mean temperature of the month shows the weather to have been somewhat warmer than the seasonal average, contrary to popular opinion. Severe local storms were less frequent than usual during the month.

During the first part of June the rainfall was copious, though not excessive and somewhat unevenly distributed. The temperatures were near the seasonal average. From the 11th to the 18th there was generally fair weather, with abundant sunshine and a general tendency to moderately cooler weather. During the closing decade the rainfall was light and irregular in distribution, and with no marked rise in temperature. The local storms were less violent than usual during the month. The month as a whole was quite pleasant, but at its close the season was a week or ten days late.

The opening days of July were generally cloudy, with scattered showers and occasional local storms, and generally low temperature for the season. From the 5th to the 16th generally fair weather prevailed, with temperatures near the normal. On the 17th, 18th and 21st scattered showers occurred, but the rainfall was light. The humidity and high temperatures at this period produced unusually oppressive and trying weather conditions. For the remainder of the month the weather was very unsettled, with almost daily showers. July, as a whole, was an unpleasant month for the midsummer season.

During the first twelve days of August cloudy weather prevailed, with frequent showers and thunderstorms. The humidity was also high during this period. From the 12th to the 20th clear weather prevailed, with normal temperatures, except on the 18th and 19th, when the maximas were extremely high. The weather was cloudy from the 20th to the 23d, with high temperature and humidity, resulting in a number of severe thunderstorms. The remainder of the month was clear, cool and pleasant. The rainfall of the month was very unevenly distributed. There was an average amount of sunshine.

September opened with several days of rather cool weather. Light showers occurred on the 3d, but from that date to the 12th there was almost an entire absence of rain. The temperatures during this period were generally in excess of the average. There were light showers on the 13th and 14th, followed by fair weather, with seasonal temperatures, till the 19th. The 18th and 19th were very warm days.

Copious rains fell on the 20th to 23d, inclusive. There was a cool wave on the 24th to 26th, with light frosts in some sections. As a whole, the month was very pleasant and characteristic of the season.

The weather of October was generally characteristic of the season. The month opened with several days of fair weather, with temperatures somewhat below the average, and the first rain, moderate showers, occurred on the 6th. During the 9th and morning of the 10th a general storm passed over the State that caused moderate to copious and excessive rains in all sections. In some sections it was attended by high winds, and in some localities more or less damage resulted from the overflowing of streams, washing of roads and fields and the flooding of cellars. Moderate rains were prevalent on the 20th and 21st, followed by several days of generally fair weather. The month closed with rains on the 30th and 31st, with low temperatures. From the 18th to the 28th the weather was very mild. October, as a whole, was an exceptionally pleasant month, with the monthly temperature slightly below the normal and a substantial deficiency in the rainfall.

The first week of November was generally fair and clear. During the remainder of the month there were very few days without rain in some section of the State. The precipitation for the month as a whole was, however, considerably below the average. Snow fell in appreciable amounts in nearly all sections, and in some interior and northern portions the monthly amount somewhat exceeded a foot. The temperatures did not depart greatly from those usually experienced at this season of the year. Generally speaking, however, the weather was more severe than usual for November. The chief storm occurred on the 15th and 16th, and was of marked severity. The precipitation during the passage of the storm was heavy, being rain in southeastern sections and moist snow elsewhere.

The marked features of the weather during December were the large amount of cloudiness, frequent precipitation and a marked deficiency in the temperature. The precipitation was well distributed, occurred on an average of eleven days, generally in light to moderate amounts, and the monthly fall was generally equal to or slightly in excess of the normal. The temperature was below the average in all sections, the monthly deficiency ranging from 2° to 7°. The most marked of the cold waves were those of the 8th, 12th and the 19th. The lowest temperatures of the month occurred during the cold wave of the 8th, the mercury ranging below zero in all except coast sections. There were no severe storms of either snow or wind during the month. Viewed as a whole, the weather was characteristic of the first winter month.

METEOROLOGICAL OBSERVATORY OF THE HATCH EXPERIMENT STATION (MASSACHUSETTS AGRICULTURAL COLLEGE), AMHERST.

[Latitude, 42° 23′ 48.5″ N.; longitude, 72° 31′ 10″ W. Height of barometer above ground, 51 feet; above sea level, 273.5 feet. Height of wind instruments, 72 feet.]

ANNUAL SUMMARY FOR 1906.

Pressure (in Inches).

Maximum reduced to freezing, 30.63, February 11, 11 A.M.
Minimum reduced to freezing, 28.94, January 4, 12 M.
Maximum reduced to freezing and sea level, 30.95, February 11, 11 A.M.
Minimum reduced to freezing and sea level, 29.25, January 4, 12 M.
Mean reduced to freezing and sea level, 30.051.
Annual range, 1.70.

Air Temperature (in Degrees F.).[1]

Highest, 91.0, September 18, 3.30 P.M.
Lowest, —7.5, March 24, 7 A.M.
Mean, 47.3.
Mean of means of max. and min., 47.6.
Mean sensible (wet bulb), 42.9.
Annual range, 98.5.
Highest mean daily, 77.8, August 23.
Lowest mean daily, 4.4, December 8.
Mean maximum, 58.3.
Mean minimum, 37.0.
Mean daily range, 21.3.
Greatest daily range. 47.5, March 25.
Least daily range, 3.0, May 28, September 2, December 21.

Humidity.

Mean dew point, 38.6.
Mean force of vapor, .383.
Mean relative humidity, 77.1.

Wind.— Prevailing Direction, West, Northwest. Summary (Per Cent).

North, northwest, 13.
North, 10.
South, 12.
Northwest, 11.
Other directions, 54.
Total movement, 53.273 miles.
Greatest daily movement, 572 miles, February 28.
Least daily movement, 1 mile, February 14, May 6.
Mean daily movement, 146 miles.
Mean hourly velocity, 6.1 miles.
Maximum pressure per square foot, 12.0 pounds = 49 miles per hour, December 1, 6 P.M., N.N.W.
Maximum velocity for 5 minutes, 36 miles per hour, April 24, 2 P.M., N.N.W.; December 1, 7 P.M., W.N.W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 45.45.
Number of days on which .01 or more rain or melted snow fell, 121.
Snow total in inches, 56¼.

Weather.

Mean cloudiness observed, 50 per cent.
Total cloudiness recorded by sun thermometer, 1,794 hours = 40 per cent.
Number of clear days, 130.
Number of fair days, 140.
Number of cloudy days, 95.

Bright Sunshine.

Number of hours recorded, 2,660 = 60 per cent.

Dates of Frosts.

Last, May 20.
First, September 25.

Dates of Snow.

Last, April 23.
First, November 11.
Total days of sleighing, 57.

Gales of 50 or More Miles per Hour.

None.

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[1] Temperature in ground shelter.

J. E. OSTRANDER, *Meteorologist.*
T. A. BARRY, *Observer.*

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE

1906.

MEETINGS OF THE EXECUTIVE COMMITTEE, ACTING FOR THE BOARD.

BOSTON, Jan. 23, 1906.

The executive committee met at the office of the secretary in Boston this day at 11 o'clock A.M., a majority of the members being present.

The chairman read the call for the meeting, also an opinion from the Attorney-General, as the object of the meeting was the consideration of the protest of Mr. A. C. Stoddard against the seating of Mr. O. E. Bradway, the delegate certified as elected from the Eastern Hampden Agricultural Society.

A hearing on the matter was held, participated in by Secretary Chandler of the society, Mr. W. M. Tucker, Mr. Stoddard, Mr. Bradway and others, when the hearing was closed, and the committee —

Voted, That, taking into account the calls for the annual meeting of the Eastern Hampden Agricultural Society for dates of Dec. 4, 1905, and Jan. 3, 1906, it is the opinion of the executive committee of the State Board of Agriculture that both meetings were illegally called, and that there was no legal election of a delegate from said society to said Board.[1]

Voted, To excuse the societies delinquent in making required returns.

In April the credential of Mr. George W. Trull of Tewksbury, chosen by the Middlesex North Agricultural Society as successor to Henry S. Perham, deceased, was accepted by the executive committee, and he was assigned to the committee on institutes and public meetings.

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[1] On Feb. 3, 1906, the Eastern Hampden Agricultural Society held a legal meeting, and unanimously elected Mr. O. E. Bradway as their delegate to the State Board of Agriculture for the term of three years.

Boston, Dec. 31, 1906.

The executive committee met in the office of the secretary this day, at 2 o'clock P.M., in accordance with the following vote, passed by the trustees of the Massachusetts Agricultural College at their annual meeting on the 20th instant: —

Voted, That the recommendation of President Butterfield concerning extension work by the College be referred to the committee on course of study and faculty, with power to confer with committees of the State Board of Agriculture and of the State Grange, with power, if after such conference it seems in their judgment wise to do so, to include in the request to the Legislature a sum not to exceed $5,000.

Present: Messrs. Kilbourn, Bursley, Pratt, Spooner and Secretary Ellsworth. Of the committee on course of study and faculty: Messrs. Wheeler, Bowker, Howe, Wright, Dickinson, President Butterfield and Secretary Martin. Representing the State Grange: Messrs. Richardson, Howard, Ladd, Dennen and Clemence.

Chairman Wheeler of the committee on course of study and faculty of the trustees presided, and Secretary Ellsworth acted as secretary of the conference. The matter was discussed quite fully, most of the gentlemen present taking part, when, on motion of Mr. Dickinson, it was —

Voted, That the matter be left with a sub-committee, consisting of the president of the College, the secretary of the State Board of Agriculture and the master of the State Grange, to formulate a plan that would be mutually acceptable, and with power to call the conference together again if in their judgment it should seem advisable.

Adjourned at 5.15 P.M.

SPECIAL BUSINESS MEETINGS

OF THE

BOARD OF AGRICULTURE

1906.

SPECIAL BUSINESS MEETINGS OF THE BOARD.

FITCHBURG, July 23, 1906.

A special business meeting of the Board, in connection with the summer meeting, was held at the American House, Fitchburg, this day, at 8 o'clock P.M., Second-Vice President Pratt presiding.

Present: Messrs. Akerman, Boardman, Bradway, Butterfield, Danforth, J. L. Ellsworth, Leach, Mason, Nye, Paige, Pease, Peters, Porter, Pratt, Ross, Spooner, Trull and Worth.

Dr. Peters, chief of the Cattle Bureau, presented his ninth semiannual report, which was accepted.

Voted, To add Mr. Pratt to the committee on codification and revision of agricultural laws.

Voted, That the committee on institutes and public meetings be a committee on conference on rural progress for New England.

Voted, That Mr. Pratt be added to the committee, that the committee report at the winter meeting in December, and that it have power to arrange a meeting at its discretion.

Voted, That Messrs. Pease, Trull, Danforth, J. L. Ellsworth and Paige be a committee to draft resolutions on the death of Henry S. Perham.

SPRINGFIELD, Dec. 4, 1906.

A special business meeting of the Board, in connection with the public winter meeting, was held at Grand Army Hall, Springfield, this day, at 4.30 o'clock P.M., First Vice-President Sessions presiding.

Present: Messrs. Allen, Bailey, Boardman, Bradway, Bursley, Damon, Danforth, Albert Ellsworth, J. Lewis Ellsworth, Jewett, Kilbourn, Leach, Mason, Pease, Porter, Pratt, Rane, Ross, Sessions, Spooner, Stevens, Trull, Wellington, Williams and Worth.

The secretary presented and read the following: —

Whereas, The Massachusetts State Board of Agriculture is familiar with the efforts now being made by the National Department of Agriculture to aid the New England States in the important work of suppressing the gypsy and brown-tail moths; and

Whereas, The presence of the gypsy and brown-tail moths in Massachusetts is a standing menace not only to the agricultural and forestry interests of this State, but to all other sections of our country;

Resolved, That this Board heartily appreciates the assistance in the work of suppressing these insects now being given by the National Department of Agriculture; and be it further

Resolved, That this Board earnestly requests the Senators and Representatives of this State to the National Congress to use their influence in obtaining further and more liberal appropriations for this work.

Voted, To adopt the preambles and resolutions, print them, and send a copy to each of the Senators and Representatives from the New England States and from New York.

SUMMER FIELD MEETING

OF THE

BOARD OF AGRICULTURE,

AT

FITCHBURG.

JULY 24, 1906.

SUMMER MEETING OF THE BOARD, AT FITCHBURG.

The summer field meeting of the Board was held at Whalom Park, Lunenburg, near Fitchburg, on Tuesday, July 24.

At 9.30 o'clock A.M. Professor Cooley of the Massachusetts Agricultural College gave a demonstration on the points of the dairy cow, illustrated by animals before him, and scored cows in the presence of the audience.

At 10.15 Mr. Henry M. Howard of West Newton demonstrated proper methods of planting, setting and caring for market-garden crops, particularly lettuce, celery and cauliflower.

At 11 Mr. Walter H. Blodget of Worcester assisted by Mr. Wm. P. Thayer, demonstrated the proper methods of packing apples for the domestic and foreign markets.

At 11.45 Mr. W. D. Rudd of Natick demonstrated the killing and preparation of poultry for the market, showing the most approved methods of preparation for the Boston market in all their details. He was assisted by Mr. John McArdle of Cambridge.

Dinner was served at the public dining hall on the grounds at 12.30 P.M., at 50 cents per plate, to about 450 persons.

At 1.15 o'clock the afternoon exercises began, Second Vice-President Pratt presiding. Governor Chas. J. Bell of Vermont gave an address on "The charms of rural life in New England;" Lieutenant-Governor Draper of Massachusetts, President Butterfield of the Massachusetts Agricultural College and President H. O. Mead of the Worcester North Agricultural Society made short addresses.

A visit of inspection was then taken to the farm of Mr. George N. Proctor, a short distance from the park, and one of the finest farms in the country.

The meeting was pronounced a decided success; the attendance being variously estimated at from 1,000 to 2,000 persons.

An abstract of Governor Bell's address follows.

THE CHARMS OF RURAL LIFE IN NEW ENGLAND.

BY GOVERNOR CHAS. J. BELL, HARDWICK, VT.

Rural life has a far greater variety of attractions than any other. This is especially true of New England. Yet there are those who do not seem to appreciate the value of their natural surroundings, and who spend their whole busy lives wondering why the Creator, when He made the universe, saw fit to make it so uneven, and then expected people to earn their living from the earth among the hills.

Yet among these same hills and mountains are broad and fertile valleys, where can be grown the greatest variety of all kinds of crops. Our friends from the prairie States often wonder why we are able to grow so much farm produce on so few acres. New England enjoys the distinction of being able to raise a greater variety of the substantials of life than any other part of the United States. Indeed, it is an oft-repeated fact that, in my own sturdy little State of Vermont, we can grow everything required in the way of clothing and food, — I mean, of course, the essentials, — except the one common article of salt. Now, as we all know, the men and women of New England are the salt of the earth, so even this commodity would not be greatly missed in time of need.

While New England's greatest staple product, in an agricultural way, is hay, we are able to fortify our thrift by an abundant output of grain and fruit. In the past the New England farmer has suffered his calling to be looked down upon and in a way belittled, and, indeed, has himself often expressed the belief that New England is no place for the agriculturist, but the man who chooses farming for a life work must go to the broader fields of the great west to win success. This is not necessary. Right here in New England, between the Atlantic Ocean and Lake Champlain, the Canadian line and Long Island Sound, all the many advantages of a rural life are best exemplified.

To-day the farmer has come to realize that his calling is an important and honorable one. He is happy; he is contented; he is industrious; he is thrifty; he is successful. The advent of the free delivery, the telephone and all the other modern methods of communication bring the inhabitants of our hills and valleys into closer touch with the great outside world, and make it convenient and possible in the beauty of our home surroundings to enjoy the pleasures and advantages, and even some of the luxuries, of the town and city, without any of the attendant objectionable features. Many a city resident would give much of his wealth for the beautiful landscape view from many of our farmhouse windows. In the city we see largely the handwork of man. In the country the wisdom wrought by the Ruler of the Universe is made manifest in the mountains, hills, trees, lakes, rivers, birds, and the little mountain brooks that wind their way so beautifully among the rocks in their glad race to meet the great river below. The trouble with the "Man with the Hoe" is, that he looks down, and never looks up.

The New England farmer has health, happiness and success by dignifying his labor, by stopping long enough from his work to appreciate his wonderful surroundings and the marvels of nature all about him.

The dignity of labor on the farm is becoming more and more manifest. It shows itself in the more frequent attempts to beautify one's surroundings and in making the home life more attractive. The farmer is coming to realize that it is necessary for him, in order to insure success, to prepare himself for the noble calling he has chosen. In the professions and other callings in life men spend much time and effort to fit themselves for their life work. This is just as necessary for the man on the farm who wants to make the most of life. This preparation is made possible through the agricultural college; the work of the board of agriculture; and last, but by no means least, the systematic work of the grange.

In his natural home surroundings the New England farmer certainly has the advantage of his city cousin. One home, properly fitted for the whole year, meets his requirements; while the man from the city has to retire to his cottage in the country for a portion of the year, at least, in order to receive the rest and recreation, pure air and wholesome food necessary for him in order that he may have the strength of muscle and mind to carry him through the strenuous duties of the hurried metropolitan business or professional life of the present day. These are blessings that the farmer may rightfully regard as his stock in trade. They surround him on every side; indeed, they are so common to him that he is too often apt to forget their worth and lose sight of their real necessity and priceless value.

Raised amid these natural surroundings, it is not to be wondered at that the nation turns to the hills for its strong men and noble women. Nature's noblemen always come from the mountains. It is from the farm homes of New England that will come the boys and girls taught to honor and dignify labor and any honest toil, on whom the larger enterprises of the world must depend for success. The simple life of the farm makes strong character.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

SPRINGFIELD.

DECEMBER 4, 5 AND 6, 1906.

PUBLIC WINTER MEETING OF THE BOARD, AT SPRINGFIELD.

The annual public winter meeting of the State Board of Agriculture was held at Grand Army Hall, Springfield, on Tuesday, Wednesday and Thursday, December 4, 5 and 6. The first two days were fair and cold; the third day was rainy. The attendance, though not unusually large, was good, and the meeting was looked upon as a decided success.

The meeting was called to order at 10 A.M. by Secretary Ellsworth, who introduced First Vice-President Sessions as the presiding officer for the morning session.

Prayer was offered by Bishop A. H. Vinton of Springfield.

The Chair introduced President Bowman of the Springfield Board of Trade, who delivered the address of welcome.

ADDRESS OF WELCOME, BY PRESIDENT HENRY H. BOWMAN.

Mr. Chairman, members of the State Board of Agriculture, and gentlemen: When I was a boy I lived in Sunderland, in Franklin County, and began to see what has since become a pathetic sight throughout New England, — the abandonment of many farms upon the hills, because the boys wanted to go to the cities, and the father and grandfather grew old and passed away. It seemed almost impossible then for any young and active, vigorous and ambitious man to wrest anything like a living from the rugged hills of New England. We are seeing to-day, I think, the reverse of that experience. All of us who know anything of rural New England are more or less familiar with the new methods that are being introduced, in the scientific way in which farming, and sheep raising, and fruit growing, and the other industries incidental to agriculture, are being pursued throughout New England. We are seeing, I believe, the dawning of a better day, and the oncoming of that day when even the rugged hills of New England, that have seemed in the past to refuse to give up to those who tilled their rugged soil, through scientific knowledge and understanding will yield to their tillers a rich harvest. But it isn't an easy thing.

A gentleman in this hall said to me this morning, when I came in, "I suppose the delegates to this convention are mostly farmers by way of pleasure, and not the real thing;" but I know some of you, whose faces I recognize, are the real thing. I think we all know some men in New England — there are some in my own native town — who are getting on, not perhaps wealthy as wealth is counted these days, but comfortably off, from land which the father and grandfather of the man who now tills the same land found it almost impossible to live upon. But it isn't an easy task that the farmers of New England have set before them.

Your chairman has said that the State Board of Agriculture is here by invitation of the Board of Trade. That is true, and of that body I have the honor to be president. Its scope is broad, and it does not believe that anything that interests the civic life or concerns the interests of Springfield is outside its legitimate work. So this we conceive to be our work, and to Springfield we bid you welcome. We hope that you will enjoy your stay here, that the meetings will be full of interest, and that you will make new acquaintances and we shall get new ideas. In behalf of the Board of Trade I tender to you, one and all, the freedom of the city, and ask you, if there is anything that the president or the members of the Board, as you come in contact with them, can do for your comfort or assistance, that you will not hesitate to ask it; because we desire, this invitation having been so courteously accepted on your part, that there shall be nothing left undone on our part to make your visit pleasant and profitable.

RESPONSE FOR THE BOARD OF AGRICULTURE, BY FIRST VICE-PRESIDENT WM. R. SESSIONS.

This Board of Agriculture is very glad to come to Springfield, the queen city of the Connecticut valley, in response to the invitation of the Springfield Board of Trade. Doubtless the Board of Agriculture would have been here at a public winter meeting before, had it not been for the decadence of the old Hampden Agricultural Society, leaving the territory of which this city is the center without official representation on the Board, and with no agricultural society to invite it to come.

This Board remembers that the Connecticut valley is the garden of the State, and it knows of the great milk product of the town of Agawam; of the productive market gardens of West Springfield and South Hadley; of the big tobacco fields of Hatfield, Whately and Deerfield; of the thousands of bushels of onions from the fields of Sunderland and Hadley; of the loads of peaches from Wilbraham; of the apples of Blandford and the other towns on the borders of the valley; and of the fine herds of pure-bred stock of Franklin County and the other parts of the valley.

The Board of Agriculture has accepted the invitation of your Board of Trade, Mr. President, with the hope and expectation of meeting here the many intelligent and successful farmers of this valley, and from them to gain inspiration and instruction in the work assigned to the Board of Agriculture by the laws of the State. We bring with us experts and experienced men in various lines of agriculture, who we expect will transmit information and inspiration to the producers of this valley, and so help on to greater service the agriculture of the Old Bay State.

This Board is happy to come to this city of homes and fine hotels for its three-days meeting, and it hopes that the programme of the meeting will appeal to the residents of the city as well as to those who live in the farming districts, and that we may have a most successful meeting.

It has always been the policy of the Massachusetts Board of Agriculture to spread its opportunities as evenly over the

State as possible, so that every one interested may, as nearly as may be, have an equal share of benefit.

Of the forty-four public winter meetings held by the Board, thirteen have been held in this valley, — three in Springfield, including this one, three in Greenfield, two in Northampton, two in Amherst, two in Westfield, and one in Easthampton; five have been held in Berkshire County, four in western Worcester County, five in the city of Worcester, three in eastern Worcester County, six in Middlesex County, three in Essex County, two in Plymouth County, two in Bristol County and one in Boston.

The one hundred and twenty-five farmers' institutes held each season are held in all parts of the State, and in such locations, it is believed, as to enable nearly every farmer in the State to attend one or more of them.

The publications of the Board, the annual volume "Agriculture of Massachusetts," the crop reports and the nature leaflets are distributed with care, and effort is made to have them placed in the hands of every one interested.

But you are waiting for the lecture of the morning, and I will not detain you longer. Again for the Board of Agriculture thanking the Board of Trade for its invitation, and you, Mr. President, for your cordial and eloquent welcome, I will give way to weightier matters, and call upon the lecturer for the morning session, Prof. L. R. Jones, botanist of the Vermont Agricultural Experiment Station, who will speak to us on the important subject of "Plant Diseases."

PLANT DISEASES.

BY PROF. L. R. JONES, BURLINGTON, VT.

It is with much diffidence that I have accepted the invitation of your honorable secretary to address a Massachusetts audience upon the subject of plant diseases. I am aware that one of the earliest and most far-sighted measures of the colonial assembly of Massachusetts was the enactment in 1755 of a law requiring the extermination of every barberry bush in your Commonwealth. Why? The botanist did not know, the agricultural scientist, if he then existed, did not know, but the farmers of Massachusetts knew that in some way that barberry bush was breeding disease in their wheat. Your practice led our science by a full century.

And I am the more diffident at crossing the State line in the capacity of a teacher in plant pathology, since from my student days I, in common with other workers in this field, have looked to Massachusetts for our strongest leadership. Foremost among these leaders stands Professor Farlow of Harvard University, who for over thirty years by precept and practice has emphasized the importance of the most painstaking thoroughness in the study of the fungous parasites which cause some of the worst of these diseases. Moreover, from your Agricultural College at Amherst two men have been instructing you, and us of other States, for nearly two decades; and the emphasis of their teachings has been laid upon matters of such fundamental importance that I can do nothing more useful than to repeat and accentuate them. The foundation doctrine in Professor Humphrey's teaching was, that in dealing with a plant disease understanding of the *causes* must precede the successful application of *reme-*

dies. On the other hand, Professor Stone is consistently and effectively directing attention to the fact that a condition of health is the natural or normal thing with the plant, and that if we as cultivators do our part by making the conditions right for the normal development of the plant, many of these troublesome problems of disease are thereby solved in advance.

Here, then, are three fundamental ideas which your three Massachusetts teachers have respectively emphasized: —

1. Understanding of cause is necessary to the most effective application of remedy.

2. If the cause is a parasite, no pains is to be spared until every stage of its development is understood.

3. The first essential in the prevention of plant disease is to supply the plant with the conditions for its best normal development.

Certainly it would be hard to define a fourth point to be entered in the same class with these. What I shall have to say may be regarded rather as throwing a side light upon each of them in turn, — a light which I trust will in the end make all of these three points stand out in fuller clearness, and at the same time fuse their respective messages into a common one, and bring this home more clearly to the plant cultivator.

My aim in this forenoon's conference will be to make clear my conviction that, if you are to understand the maladies of your plants as practical cultivators seeking to know cause and remedy, you must study them not as isolated diseases, but always as having intricate relationships. These relationships are, moreover, of two general classes: —

First, there are the interrelationships between the different diseases which attack the same plant. Misfortunes seldom come singly, bug and blight and rot co-operate in their havoc; and, while the scientist may study them singly, the cultivator who would save his plant must fight them in the aggregate.

Second, there are the relationships with the plant, not merely at the moment of attack, but such as can be understood only by a consideration of the particular nature of the plant, its development as an individual, and, indeed, its origin and history as a cultivated race.

It follows, then, that the important thing from the practical standpoint is to study all the maladies of each crop, both in relation to each other and in relation to the development and history of that particular crop. To make this the more clear, let us at once consider and compare the respective diseases of two of the commonest of our cultivated plants, — the apple and the potato. We will first enumerate their maladies that we may clearly classify and compare them; then proceed to a discussion of the relation of these to the history and development of the respective plants.

Some of the Commonest Diseases of the Potato, classified as to Cause.[1]

Name of Disease.	Cause.
1. Scab of the tuber, ...	A fungus, — *Oospora scabies.*
2. Late blight of leaves (often called "rust," and rot of tubers).	A fungus, — *Phytophthora infestans.*
3. Early blight, or leaf spot, . .	A fungus, — *Alternaria solani.*
4. Leaf blotch, ...	A fungus, — *Cercospora concors.*
5. Black-leg and possibly some rot, .	Either fungus, — *Rhizoctonia* (?) or bacterial, — *Bacillus* (?).
6. Bacteriosis, wilt of tops and rot of tubers.	Bacteria, — *Bacillus solanacearum.*
7. Internal browning of the tubers, .	A physiological disorder, probably associated with improper water supply.
8. Sun-scald of leaves, . . .	A physiological disorder, due to sudden excessive evaporation.
9. Tip-burn of leaves, ...	A physiological disorder, due to long-continued dry heat.
10. Arsenical poisoning, . . .	A physiological disorder, from improper use of poisons.
11. Colorado beetle, ...	An insect, — *Doryphora decemlineata.*
12. Flea beetle, ...	An insect, — *Crepidodera cucumeris.*
13. Grasshoppers, ...	Insects, — *Melanoplus sp.*
14. Stem borer or stalk weevil, . .	An insect, — *Trichobaris trimotata.*

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[1] In connection with the discussion of the above maladies, the speaker exhibited an illustrative series of specimens and charts, and incidentally discussed the specific remedies.

Some of the Commonest Diseases of the Apple, classified as to Cause.

NAME OF DISEASE.	Cause.
1. Scab of leaf and fruit, . . .	A fungus, — *Venturia inaequalis.*
2. Rust of leaves, ...	A fungus, — *Gymnosporanzium macropus.*
3. Leaf spot, ...	A fungus, — *Phyllosticta pirina.*
4. Sooty blotch of fruit, . . .	A fungus, — *Phyllachora pomigena.*
5. Canker of limbs and black rot of fruit.	A fungus, — *Sphaeropsis malorum.*
6. Fire-blight of twigs, and possibly some body blight.	Bacteria, — *Bacillus amylovorus.*
7. Brown spot of fruit, . . .	A physiological disorder, probably associated with water distribution.
8. Scald of the fruit, ...	A physiological disorder, resulting in improper maturing.
9. Frost bands on the fruit, . .	A physiological disorder, the result of climatic conditions.
10. Russeting of sprayed fruit, . .	A physiological disorder, resulting from the poisonous action of spray compounds under certain conditions.
11. Codlin moth, ...	An insect, — *Carpocapsa pominella.*
12. Apple maggot, or "railroad worm,"	An insect, — *Trypeta pominella.*
13. Scales, ...	Insects, — *Aspidotus perniciosus*, etc.
14. Borers, ...	Insects, — *Chrysobothris femorata*, etc.

I have purposely grouped these in similar order, so that, by comparing the maladies of the one group with those of the other, number by number, the striking parallelism will be apparent. This parallelism holds not only as to the common names of the diseases, but in their classification as to general cause. It has therefore appealed to the scientific specialist, — the man whose work is primarily in the laboratory inquiring into the specific causes of these various maladies, for information can only be handled in the scientific spirit in proportion as it is classified. Nor would I minimize the importance to the practical man of seeing and learning the significance of the above scheme of classification, and even of committing to memory the Latin names of his chief enemies. It is a great aid to intelligence and definiteness in thinking thus clearly to group the causes of these plant maladies under the four heads, — insect, fungous, bacterial and physiological.

But I would emphasize the point that the help thus coming to the practical man is but general and vague, — it stops short of the most immediate and close applications. I would maintain that for the best practical understanding of plant diseases we must classify not according to cause primarily, but according to plant; that is, we must aim to understand all the maladies of each crop, and that in their *relations*, especially their relations to each other and to the development of that particular plant. This will involve a consideration of many things not ordinarily brought out in the discussion of plant diseases. Among these are the origin and history of that plant under human culture; the life history of the individual plant, and a consideration of its developmental stages; the relation and adaptation of the crop to its environment, especially to climate and soil; the interrelations of the various maladies; and, finally, the variations in individual plants and varieties as to their relative liability to these maladies, — that is, their relative powers of disease resistance.

Every one of these matters may stand in the closest relation to the practical questions of the cause, spread and prevention of plant diseases. That we may realize more fully the importance of such considerations, let us again consider and compare the apple and the potato as regards these matters.

First, the apple. The origin of the apple as a cultivated plant antedates recorded history. It is said that charred remains of the fruit are found in the prehistoric lake dwellings of Switzerland. For unnumbered thousands of years man has been using, cultivating, selecting, seeding and perhaps grafting this fruit. The apple is a native of southwestern Asia and the adjacent regions of Europe, — regions lying within the north-temperate zone, with seasonal changes and temperature extremes essentially like our own, but characterized by less uniform moisture. In cultivating this fruit man has sought only its flesh. He has therefore confined his attempts at modification by breeding and selection to the increase of the amount of this, the amelioration of its flavor, texture and keeping qualities, and incidentally to color characters. As a result, we have to-day innumerable varieties of the cultivated apple, showing extreme variations in these respects. But the part of the plant which has thus been modified is an unessential thing in the fundamental life processes of the organism. The essential structures of the apple, — those that are important to its nutritive and reproductive processes, — are root, stem, leaf, flower and seed; and man in all these centuries of culture has not modified any one of these beyond the range of its natural variations. We have the important result that the cultivated apple is a plant which still retains essentially the normal structures and functional activities of its wild ancestors; that its normal physiological equilibrium has not been disturbed. It is further noteworthy, as a corollary of the above, that the apple, like its wild ancestors, is a slow-growing tree, of great individual vitality and almost indefinite longevity.

Now, what are some of the bearings of these facts upon the practical questions of apple maladies and their control? First we may note that the long culture and wide geographical distribution have led to an enormous accretion of possible plagues in the shape of insects and fungi which may prey upon it. I will not weary you by enumerating these in detail, but simply state that Saccardo in his list of the known fungi of the world enumerates over 250 species which have been found on the apple. This, you understand, refers to fungi alone, without reference to bacterial or insect pests. Yet in spite of this fact there are few plants in common cultivation which are less liable to be killed outright by such enemies. The borer, indeed, is about the only parasite that actually threatens the life of an apple tree when it is once well established in a suitable New England soil. There are leaf pests, fungi and insects galore, which curtail our apple crops, but they do not seem capable of really shortening the life of the tree itself. Each year the apple tree sheds its diseased leaves in the autumn, and appears the following May arrayed in a perfect coating of healthy green. What would man not give for a like power of renewing his youthful vigor!

Two other matters are worthy of remark, as showing how intimately the diseases of the apple are related to its place and mode of origin. As already noted, the climate of the Asiatic and European regions where it is native is a dry one. It is significant, upon reviewing the diseases of the apple, to find that rarely if ever does serious disease result in our climate from insufficient water; but, on the other hand, the most serious fungous pests of New England, the scab and the sooty blotch, and in the south the bitter rot, are associated with excessive moisture.[1]

It is further noteworthy that the parts where the most rapid and serious injury is wrought by the widest variety of maladies is the part most modified under human culture and selection, — that is to say, the flesh of the fruit. This is the weakened organ, attacked most violently by scab, and mold, and blotch, and worm, and maggot, and curculio. But recall how few of these pests really affect the production and maturing of an ample crop of seeds, which is, after all, the essential end in the normal life processes of the apple as a living organism.

Finally, let us inquire as to the relation of varieties to disease. In nature there is always the struggle for existence, and the inexorable law of the survival of the fittest has as its corollary the elimination of the unfit. It is the operation of this law through countless generations, we may believe, which has given the vigor to the essential parts and organs of the apple tree which enable each and all of them which man has not disturbed to bear their quota of ailments without real danger to life.

But man, in his selection of varieties for pleasing flesh of fruit, has scarce given practical consideration to this as yet. Are there no differences, then? Every boy knows there are. He knows that in the old orchard the fruit of certain varieties will ripen prematurely in advance of others; and he knows that it is because the worm, as well as he, has a peculiar fondness for that fruit. Every one knows that the scab ruins certain varieties, while others are practically immune. I have seen two trees, one a Russian, the other an American variety, with branches intermingled. In August every leaf on the American was brown with rust, and the tree was annually stripped of its foliage in August until the adjacent red cedar which harbored the rust fungus was removed. In striking contrast was the Russian variety, upon which careful search failed to reveal a single rusty leaf. There is, therefore, a remarkable difference in disease-resistance between the various varieties of apples.

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[1] The author is indebted to Mr. M. B. Waite of the United States Department of Agriculture for calling his attention to this relation, as well as to certain of the other facts presented, in the course of lectures on apple diseases delivered by Mr. Waite at the Graduate School of Agriculture, University of Illinois, July, 1906.

But what attention has as yet been given to this? Who in this country is well informed as to the relative disease resistance of even our standard varieties, to say nothing of the newer ones that are being introduced? We have recently been searching pomological literature and corresponding with experiment station workers and other experts over the country, and are surprised to find that no systematic attempt has as yet been made even to collect and compare the results of chance individual observation, much less to make more exact and systematic observations, experiments and comparisons. The possibilities of actually improving varieties as to disease resistance by systematic breeding and selection are still more remote, owing, of course, to the time element in apple improvement. Yet both of these matters are of most fundamental importance, as related to the practical operations of apple culture.

Let us now make similar inquiries as to the relation of the history and development of the potato to its diseases, that the results may be compared with the conclusions already reached for the apple. The aim will be at the same time to examine the bearing of such considerations upon certain questions of potato culture and disease control. When at the outset the diseases of these two plants were listed and classified as to causes, a remarkable likeness was apparent, amounting almost to a parallelism. As we proceed now to this later and as I believe more practically helpful method of consideration, the results will be different. I wish to prepare you by a summary in advance, that you may see how striking this difference is, and may the more readily follow the details of the discussion, — details which will reveal no such parallelism, but instead a marked contrast between the two plants in almost every particular.

Summary contrasting the History and Development of the Potato with that of the Apple.

Apple.	*Potato.*
1. Culture antedates recorded history.	1. Culture relatively modern.
2. Original home in north temperate regions of Asia and Europe.	2. Original home on the plateaus of tropical or sub-tropical America.
3. Season like our own; climate dryer.	3. Season much longer than our own; climate moister.
4. It is fully acclimatized and domesticated as cultivated here.	4. It remains a half-wild foreigner still.
5. It has not been modified in its essential life processes or structures.	5. It has been fundamentally modified in its essential life processes and structures.
6. Its normal sexual reproductive processes leading to seed formation remain unimpaired.	6. Sexual (seed) reproduction is almost lost, and the vegetative process (tuber formation) substituted.
7. It is a long-lived tree.	7. A short-lived herb, perennial by tubers.
8. Therefore, but slightly and slowly affected by unfavorable environment (soil and atmosphere).	8. Liable to quick-acting and even fatal diseases associated with unfavorable environment (soil and atmosphere).
9. Varieties have great stability, deteriorating but slowly, if at all.	9. Varieties unstable, and deteriorate or "run out" in a few years.

The conclusions from the above comparison may be summed up by saying that, whereas the apple as we have it in culture is in stable equilibrium structurally and physiologically, the potato is in most unstable equilibrium. As a practical result, the potato is of all our staple farm and garden crops the most liable to destructive diseases, of which the causes are most complicated and the fundamental remedies the least understood.

The full justification of this conclusion requires a somewhat more detailed consideration of the facts we have summarized above.

The potato is a semi-tropical plant, which has been brought under cultivation in our northern climate by rapid and intensive breeding. Its ancestors occur as natives in the Andean plateaus of South America, and as far north as Mexico. For advice on the latter point I am indebted to my associate, Cyrus G. Pringle, the veteran botanical explorer of Mexico, who finds the potato there both wild and half domesticated, and he has told me of its natural habits. This plant has been in common culture by white men for less than two centuries; and, indeed, it is within a generation that Goodrich and others have brought new strains from their tropical homes and developed from them the best of our present varieties. Now, what is the result? Our northern season of growth is shorter by one-third or even one-half than that of its natural habitat. There, the potato plant reproduces itself primarily by seeds and secondarily by tubers. Here, by intensive breeding, selection and high culture, man has so changed the conditions that seed production is almost unknown, while the size of the tubers is enormously increased.

In Mexico and southward it starts into growth in March, and reaches full maturity in December, — a season covering three-quarters of the year, as contrasted with ours of from three to five months. There the period of blossoming and seed maturing occurs in August and September, whereas the tuber formation follows after the ripening of the seed, during the last two months of the growth. Now, reproduction by seed is a sexual process; that by tubers is vegetative. Both are exhaustive of the vital forces of the plant. In a certain physiological sense the two are opposed to each other, representing opposite tendencies within the plant, therefore, they cannot well be carried on by the plant at the same time. In the natural state of the potato they are not. As we have explained above, seed formation precedes by some weeks, the long season of growth there permitting this. But with the cultivated potato in our short season and under intensive culture we have crowded the two processes together till they overlap. Dig up a potato plant when in blossom, and you will find it starting to form tubers also. That is, we have forced tuber production back into the period which in the wild plant is given to the formation of flowers and seeds. According to the mode of life of its ancestors, such a plant should be throwing all of its energies upward to perfect the flower and mature its seed balls. But tuber production in our highly specialized garden plant immediately lays claim to the major part of the reproductive energies of the plant. As a result of this conflict of tendencies in the plant, there occurs just at the close of blossoming time a condition which I term the *critical period* in the life of the potato plant, during which the continued health of the plant, if not its very life, hangs, as it were, in the balance. This is the turning point, the crisis, in the life of the plant. Before this time it is a plant of remarkable vegetative vigor, which will quickly recover from very severe ravages of insects or other adverse conditions ; a little later it will do the same ; but serious injury to the foliage or arrest of development by unfavorable soil conditions at this period will start the plant upon a decline which continues to its death. No subsequent treatment, therefore, can make amends for neglect during this critical period. If, however, the plant is carried in full vigor through this crisis, it starts upon what is virtually a new lease of life, — a vegetative period which with the more vigorous varieties in far northern climates seems to have no clearly defined natural terminus. It is during this second or vegetative period that the marketable crop is developed. It is for this that we have grown the plant. It is therefore worth while to know exactly what happens during it, — to trace the rate of growth of the real potato crop, the tubers.

This has been done at the Vermont Experiment Station during three seasons, by beginning just after the blossoming period and making partial diggings at ten-day intervals. The plants were of course sprayed, to maintain life to full maturity. The results were surprising to us at first, and are of great practical importance. They show that with our vigorous main crop varieties, even in northern Vermont, where properly protected there is a possible period of from eight to ten weeks for the tuber formation and growth ; and, moreover, that *the last half of this period is the most valuable part.* The following table shows the results we obtained one year, which may illustrate this important point more clearly : —

The Development of the Potato Tuber. — *White Star Potatoes, planted May 20, at Burlington, Vt.* (*Yields and Sizes of Tubers at Different Dates.*)

DATE OF DIGGING.	Total Yield per Acre (Bushels).	Yield of Marketable Size (Bushels).	Average Size of Tubers (Ounces.)
August 2, . . .	58	30	1.6
August 12, . . .	115	75	2.0
August 22, . . .	230	163	3.7
September 1, . . .	304	234	4.4
September 12, . . .	356	303	5.2
September 22, . . .	379	353	5.7

It is evident at a glance, therefore, that more than one-half of the marketable crop was developed after the third week of August, and the results of similar trials two other years bear out this general conclusion.

Here, then, we have the standard by which we may measure the relation of the diseases of the potato to its development; for it is at this critical period and immediately subsequent to it — in other words, in the early stages of this possible formation — that the most destructive potato maladies occur. As said, these plants were properly sprayed to give full protection against insects and blights of all kinds; moreover, they were kept free from weeds. It is only as perfect root and leaf activity is thus made possible that such full development can occur. This will become the more evident as we inquire into the conditions necessary for nutrition and growth of the plant.

The potato tuber carries about 79 per cent of water, 17 per cent of starch, and 1 per cent of mineral matter. It is evident, therefore, that the chief requirements for the nutrition of the plant during the period of tuber formation are not commercial or other fertilizers to supply the mineral matter, although they are in their minor way important, but adequate provisions for furnishing the water and starch; and of these, the first is water. To grow the plant, indeed, requires not merely the 80 per cent of water which is stored in the tubers, but vastly more which is given off from the foliage day by day. As nearly as we can calculate, there is needed, to produce a crop of 300 bushels of potatoes per acre, an amount of water equal to a layer covering the entire surface of that soil to a depth of 7 inches; and 400 bushels per acre will require an amount equalling a layer 9 or 10 inches deep. To supply this requires more water than falls during the season of most rapid growth. The soil must, therefore, be in such physical condition, owing to humus content and tilth, that it will store the water and yield it upon demand to the roots; and the husbandman must see that there is no loss of this precious water through robbing weeds or wasteful evaporation from the surface of the soil. Hence, clean culture and the earth mulch are essential to the highest development of the plant, until by its own foliage it completely covers the surface of the ground. Lack of sufficient water is the chief cause of sun-scald and tip-burn, — two of the commonest forms of premature death or blighting of potato leaves. Another potent factor contributing to this same end is the attack of that minute insect pest the flea beetle, which so riddles many of the leaves about blossoming time that they soon dry out, "burn" and die. Spraying, as described later, will entirely prevent this injury.

Starch is to be rated next to water in the plant's nutrition. Every grain of starch in the potato tuber was originally made in the green tops, chiefly the leaves. The potato leaf is one of the most marvellous of chemical laboratories, since therein, by a process of which no scientist knows the details, the green tissue, invigorated by the sunlight, absorbs the carbon-containing gas from the air and the water from the roots and combines them — the gas and the liquid — into the solid known as starch. Nature never fails in supplying enough air, and rarely is sunlight lacking. The cultivator must see that the water supply is adequate, as already indicated. The plant naturally develops ample leaves for a bountiful starch production, but the assistance of man is necessary for their continued protection. Every leaf that is lost during the later growth of the plant means a proportional reduction of the starch-making capacity of the plant, and thus a direct reduction of the crop. If we realize this, and recall the consequence of the attacks of insects and blights upon the foliage of the average potato field immediately following the blossoming period, we can readily understand why the average yields of potatoes in Massachusetts and Vermont fall below 100 bushels per acre. From one-half to two-thirds of the possible crop is sacrificed, and chiefly because the leaves are not protected against these enemies.

Moreover, this loss is entirely unnecessary to-day. A decade or so ago it was excusable, for Paris green and plaster, which were the only remedies intelligently used then, do not suffice to furnish such protection in the later life of the plant. But repeated trials, extending now at the Vermont station through some fifteen successive years, have shown that practically perfect protection against all these maladies, insects and blights alike, is secured by the proper use of Bordeaux mixture, either alone or combined with arsenites.

As practical evidence of this, your attention is invited to the following tabular summary of the results obtained from spraying the later main crop potatoes at the Vermont Experiment Station during this period. Of course climatic and varietal conditions influence the matter of total gain, and these results might not be duplicated in Massachusetts. But the conclusion must remain the same, — that you cannot secure a perfect development of the potato plant unless you conserve the water and preserve the leaf unmutilated to maturity; and this latter result can only be secured by proper spraying in the later stages of the life of the plant.

Gains from the Use of Bordeaux Mixture on Late Potatoes at the Vermont Experiment Station. (Bushels of Tubers per Acre.)

VARIETY.	Planted.	Sprayed.	YIELD PER ACRE.		Gain per Acre.
			Where sprayed.	Where not sprayed.	
White Star,	May 11, 1891.	Twice.	313	248	65
White Star,	May 20, 1892.	Three times.	291	99	192
White Star,	May 20, 1893.	Three times.	338	114	224
White Star,	April 26, 1894.	Three times.	323	251	72
White Star,	May 20, 1895.	Three times.	389	219	170
Polaris,	May 15, 1896.	Twice.	325	257	68
Polaris,	June 1, 1897.	Three times.	151	80	71
White Star,	May 10, 1898.	Twice.	238	112	126
Average three varieties,	May 18, 1899.	Three times.	229	161	68
Delaware,	May 23, 1900.	Twice.	285	225	60
Delaware,	May 25, 1901.	Twice.	170	54	116
Delaware,	May 15, 1902.	Twice.	298	164	134
Green Mountain,	May 1, 1903.	Once.	361	237	124
Delaware,	May 25, 1904.	Twice.	327	193	134
Delaware,	May 15, 1905.	Twice.	382	221	171
Averages for fifteen years,			295	176	119

I trust that what has been said has sufficed at least to make clear the fundamental propositions outlined at the beginning; namely, that the understanding of plant diseases from the practical standpoint and the intelligent application of remedial measures is conditioned upon a study of each crop by itself, — as to the correlation of its diseases with each other, and especially as to their relation to the history of the crop under human cultivation and to the development of the plant as an individual.

If so, I wish now in closing to go one step farther, — along the same line, it is true, but a step in advance. So far we have spoken of the things of which we are certain from past experience, but this last is a matter rather of hope than of assurance. When speaking of the diseases of the apple, it was noted that there is a remarkable difference in the susceptibility to disease of various varieties. Moreover, it is a matter of common knowledge that this is quite generally true among varieties of plants, as it is among races and even among individuals of the domestic animals and of man himself.

Our confidence in the fundamental likeness of life relations is such that we should expect corresponding differences to occur with potatoes. While the existence of such is recognized in a rather vague way by potato specialists, the fact has as yet had very little practical influence upon the selection or handling of seed potatoes in this country. But in Europe, where greater dependence is placed upon the potato crop, this question has received more attention. For over twenty years in Great Britain and for at least a decade in Germany both potato breeders and large growers have definitely bred and selected for this purpose, and potato growers have learned to estimate the value of new varieties with this clearly in mind.

We had opportunity to inquire carefully into this matter two years ago, and found that, in Great Britain especially, every variety of potato is rated for relative disease resistance just as clearly as it is for relative yield and marketableness. In Germany almost as much attention is being given to this matter to-day as in England and Scotland, but they have not had the matter in mind so long.

That we in America might profit from the experience of European potato growers, authorization was given us by the Department of Agriculture not only to make inquiries as to potato diseases and remedies as known in Europe, but also to secure seed of such varieties as were reputed there as being especially disease resistant. As a result, seed of about 100 varieties was imported in 1904–05, and has been on trial for two years under government supervision, not only at the Vermont station, but at some other points farther south and west. Alongside of these, some 50 of the American varieties of most promise as to immunity have been grown for comparison. The trial of these varieties in Vermont is in charge of William Stuart, professor of horticulture at this university, and the preliminary results were published by him recently in Bulletin 122 of the Vermont station. As he there states, the trials of one year or even two must not be considered as justifying final conclusions, and he has no practical recommendations to make to potato growers as yet relative to varieties for culture. Certainly none of the European varieties are as yet sufficiently tested to justify recommending them for other than trial plantings.

It is most encouraging and significant, however, to find that not only do the European varieties in general retain much of their disease-resisting qualities when grown in this country, but that they are strikingly superior to even the better of the American varieties in this respect. This will appear from the following tabular summary of the first year's results : —

Relative Disease Resistance of European and American Potatoes.

SOURCE OF SEED.	Number Varieties tested.	Per Cent of Rot on Sandy Soil.	Per Cent on Clay Soil.	Average Per Cent Rot.
Holland, . . .	5	.4	10.8	5.6
Germany, . . .	19	1.4	13.9	7.7
Great Britain, . .	68	3.9	32.7	18.3
France, . . .	6	11.3	73.1	37.2
America, . . .	55	20.0	55.1	37.6

These figures show only the averages. Professor Stuart's figures show many interesting details, which emphasize even more strongly these differences in disease liability. Thus, two varieties, one German (Irene) and one English (Eldorado), showed no rot whatever; whereas in the same field the French variety Chave showed 96 per cent rotten, and the Americans Early Rose showed 89 per cent and Ionia Seedling showed 85 per cent rotten. Two American varieties have a pretty well-established reputation among potato growers for resisting the rot, — these are the Dakota Red and Keeper. These two proved that their reputation is deserved, for in these trials they led all American varieties in this respect; but in comparison with the Europeans they were decidedly inferior, Keeper standing twenty-second and Dakota Red thirty-sixth in the list, — *i.e.*, 21 European varieties proved better than the best American in resistance to rot.

The above comparison, based only on this one factor, rot resistance of the tubers, does not answer all the practical questions, by any means, but it does serve to emphasize the remarkable differences that exist between varieties. Differences as to resistance in the blighting of the vines showed similar contrasts, though not easy to estimate with like exactness. The same variety did not always show equally good relative resistance in both leaf and tuber. For example, the new Vermont variety, Rust Proof, resists leaf blight to a high degree, but is liable to rot rather badly. There were, however, numerous varieties, especially of the Europeans, where a high degree of resistance occurred against both blight of foliage and rot of tuber. Moreover, differences in resistance to scab and to other diseases are being noted, although Professor Stuart has not as yet published the results of these observations.

While, as before stated, it is too early to make practical recommendations to growers as to the choice of varieties, certain things are at least evident. The most important are: that wide differences do occur; that certain varieties are already established, at least in Europe, of high disease-resisting quality. This should at least stimulate every potato grower and breeder to aim toward improvement in our American varieties along these lines. Unfortunately, certain facts stand temporarily and perhaps permanently in the way of our introducing the resistant varieties directly from European to American culture.

The German varieties are as a class of a coarse quality, used there for factory and stock food, rather than for table. The British varieties, on the other hand, are fine table varieties, but are not easily acclimatized here; they lose their vigor and productiveness, — at least, for a time. It is possible that with longer culture they may recover it. The outlook at present is, therefore, that American potato breeders must be depended upon — profiting from the experience of the Europeans, and using, it may be, these European varieties as parents — to produce similar disease-resisting varieties suited to American needs and conditions. We have confidence in the skill and patience of American potato breeders and in the fundamental plasticity of the potato plant, and we therefore believe that we may look forward to a day when we shall have varieties of potatoes equalling our best ones in all other respects, and having, in addition, if not complete immunity to the various diseases the potato is heir to, at least a far higher degree of disease resistance than do our standard varieties at present.

In conclusion, then, I would repeat and summarize my conviction that man may proceed with good courage in his effort to rid his plants of disease. Success is conditional upon various things. Knowledge of cause should precede remedial measures; but where the cause is understood, and, if it be a parasite, the full life history of this is known, the practical remedy is not long in abeyance. Plants are by nature healthy, and the first effort of the grower should be so to surround them with environmental and cultural conditions that disease is kept from them. The spray pump, while often essential, is to be regarded as the last resort, the finishing touch, the insurance policy; but as such it is at present indispensable. The right understanding of the diseases of the plant require a study of the diseases of each crop, that they may be understood in their interrelations to the particular nature, history and development of the plant in question. And, finally, far more attention should be given than has yet been done to the breeding and selection of varieties with reference to their resistance to specific diseases.

Prof. Wm. P. Brooks (of Amherst). Are the European varieties which exist suited to our climate?

Professor Jones. I am very glad you raised that question. We are not in condition to-day to recommend these to any Vermont farmer, knowing what we do about them, for these reasons: the German and Holland varieties, which are the best disease resisters, are not up to our American standards, — they haven't a very good flavor; they are a coarse, factory type of potato, and are not to be recommended for American culture, unless it be for starch or alcohol making. The British varieties have good table qualities, and some of them show good disease resistance with us; but, for some reason which we cannot understand, none of the English or Scotch varieties have as yet shown in our culture the productiveness that they do in England and Scotland; they may do so later, but they are not yet up to standard for size and yield. Therefore, there is not a single one of these which is to be recommended for general culture in America at present. But it is evident that the European varieties may at least be good for breeding purposes; and the outcome of these trials should certainly encourage every potato specialist to seek to improve the disease-resistant qualities of the plant. The disease resistance is dependent not only upon the special variety, but upon the vigor of the seed. Northern-grown seed is the best. The Europeans prefer seed dug before fully mature, and from soil not highly fertilized. But, since varieties best suited to one locality and soil are not necessarily best suited to another, and since all varieties soon weaken or run out, the best developments in potato culture demand that much more attention and encouragement than heretofore be given to local potato breeders and to special seed potato growers, that they may be induced to supply for each locality the best of seed, especially suited to the needs of that particular region, and of well-proved, disease-resisting varieties.

Professor Brooks. There is one other question which I think would be of general interest, and that is my reason for asking it. The professor has referred to the loss of the characteristic of producing seed, and something that he said led me to think that his point of view was that this was due to the varieties we now cultivate. I can't say all potatoes that farmers cultivated years ago bore seed. The varieties raised on my father's farm were Jackson White and Davis Seedling, while White Chenango and Black Chenango are other names I sometimes heard, though they were not much cultivated at that time. These all bore seed balls. If we could find the Jackson White and Davis Seedling and should plant them, does the lecturer know if they would bear seed balls to-day?

Professor JONES. I can't answer directly, as I am not acquainted with those varieties; but there are a few varieties to-day that will produce some seed balls. I know of none that will produce a great many, but every potato breeder has some that he keeps for that purpose. I can perhaps answer the question in another way. I was impressed in northern Germany with the relative number of seed balls, variety after variety bearing them abundantly; but where it is a general thing for varieties to have seed balls there, the same varieties as grown at Burlington have very few. The same thing was true in Scotland and England, seed balls being relatively common. Why is it? I can't positively say, but of course I have my notions. Some say Paris green. If any one wishes to believe that, it is his privilege; but I don't believe it. What is it, then? I suspect that the principal cause lies in our climatic conditions. The short season has, as already explained, thrown the plant out of its normal physiological balance. Tuber production crowds upon seed formation; the plant cannot well do both at the same time, and we have selected these varieties which throw their reproductive forces most strongly to tuber formation. Moreover, I think that the larger amount of bright, hot, dry weather, characteristic of our climate as compared with the European, reduces the vitality of the reproductive parts of the blossom.

Hon. WM. R. SESSIONS (of Springfield). Professor Brooks's reference to old varieties of potatoes carries my mind back to when I was a boy. The principal potato raised then was the long, red potato. That was about all that was raised in our section at that time, when I had to ride the horse between the rows. My recollection of that potato is that one end was dry and the other was watery, — in fact, the food was sorted in the potato. Can you tell what the cause of that was? We don't have it to-day at all, do we? There is no potato raised but what is equally good throughout; but my recollection now is that in this old variety one end was a poor quality and the other was better.

Professor JONES. I will answer the question by putting it in a different way. I will cut this potato in two, to illustrate my meaning. A glance at this section shows that it has a watery streak through the middle. Instead of saying there is no potato raised but what is equally good all the way through, I will say there is no potato raised that is uniform all the way through. You simply had, in that variety, a far greater degree of differentiation. But the more fundamental question, of course, is, whether there are such varieties to-day; and I can't answer that. I do not know of any.

Mr. SESSIONS. In those days they raised enormous crops, — greater than anything we can count on now, I think.

Mr. E. CYRUS MILLER (of Haydenville). Will the speaker enlarge upon the varieties of apples which have been found resistant to diseases, and also the effects of cultivation and fertilization, relative to existing qualities in such apples?

Professor JONES. I will simply say that very little has been learned upon that subject, so far as I know. My assistant has been working upon this matter, and has in connection with it received advice from nearly every State in the Union. As yet very little has been definitely recorded that is of practical value as to the relative disease resistance of apples, and as to the possible relations of climate and culture.

Mr. MILLER. Do you know why the one variety is more susceptible to the scab than another?

Professor JONES. No; and we don't know why there is such a difference as I have described in potatoes. We are trying, however, to find out in the case of the potato. We find that one variety of potato resists rot, and another will rot badly. The Early Rose is a bad rotter; the German varieties resist. The difference may be in part in the character of the potato skin; but certainly it is not all there. Here is evidence in point. I am holding up for your inspection two glass tubes containing growths of the rot-causing fungus. Note that in one it is making a rank growth; that is where it is growing on a piece of Early Rose potato. In the other the growth is weak; that is growing on a piece of one of the German varieties. It is evident, therefore, that there is something in the flesh of that German potato that resists the invasion of the fungus, as compared with the Early Rose; but as yet we do not know what it is. There may also be a difference in the flesh of the apple, and in addition there may be a difference in the skin or peel. There is some reason to believe that red potatoes and rough-skinned potatoes are not so liable to disease as smooth, white-skinned varieties. It may be the russet apple similarly escapes the scab because of possessing a more resistant peel than the Fameuse; but I think there is something more than that, — some more subtle difference, resident in the living tissues of the flesh of the fruit.

Mr. MILLER. Would you agree with Professor Stone of Amherst, when he says that the resistance of the apple to disease depends in a large measure on the physical vigor and constitution of the tree? Would that be a rule to follow?

Professor JONES. That is one of the important fundamental questions. I think there is no universal rule, but that it depends, in some measure at least, on the disease. Take the brown spot on the Baldwin, for example; I would say, from all the evidence I can get, that the ranker the growth of the Baldwin the more liable it is to spot. We all know that the more rapidly growing pears are more liable to blight; but we ought not to say that rapidity of growth is a measure of physical vigor, — such growth may rather be an index of lack of balance. Certainly it holds, as a general principle, that we should aim to keep our plants in as perfect physical vigor as we can; and that, if they are in perfect balance, they will, as a rule, resist diseases better. But the above illustrations show that this rule is not easy to interpret or apply.

Mr. MILLER. How do you explain the brown spot disease of the Baldwin?

Professor JONES. It is probably due to a physiological disturbance of water content of the apple. It is not due to a germ or insect, any more than is the internal brown spot on the potato.

Mr. MILLER. How general is that trouble in Vermont?

Professor JONES. Very general some years, and other years we don't see very much of it. It isn't a trouble that reduces the selling value of our product much in Vermont, as we sell them very promptly when this shows but little.

Professor Brooks. I would like to call attention to a discovery which we have made in Amherst this past summer, partly because I think it will be of general interest, but largely because I should like to draw out Professor Jones in a slightly different line. He has stated more than once that he believes we must approach this question of disease largely from the physiological side; and, while he has attained a great degree of success in protecting the potato by spraying, I presume he would agree with me that the ideal which we should hold before ourselves is so to learn all conditions which influence the crop as to produce the crop without the spray, if practicable. Now, he has dwelt particularly on the importance of getting a resistant variety. I fully agree with him in that position. We have begun trying to produce a more rust-resistant type of asparagus. There are no discoveries to report, as yet. I have simply to say that most striking differences were observed, some individual plants being almost absolutely rust-free. I do not purpose dwelling on that particular phase of the matter. There is evidently much useful work to be done. The observation to which I refer is this: We have one field where for about eight or nine years we have been comparing different potash salts. There are seven potash salts under comparison, and we have five duplicates of every treatment. Every year during the last eight or nine one plot in each set has had no potash. The potato was the crop this year; it was clover last year. All the plots were sprayed; we began spraying early, and sprayed as thoroughly as we knew how, three times in all. We protected the potatoes from both early and late blight, and we had no rot on any of the plots in every set where we had used potash; but on the part where we had used no potash for seven or eight years the crop blighted very early, and the crops were seriously reduced. I am led to believe that there is an undiscovered country in the direction of the use of the fertilizer and the chemical condition of the soil, and I would like to hear from Professor Jones on that point.

Professor Jones. I am extremely interested in what Professor Brooks has said. It is a subject of fundamental importance, which deserves careful experimental study. In Germany, Great Britain and France considerable attention has been given to this matter of the relation of chemicals to disease. They have not only come to rely on potash and some other things as assistants to the disease resistance of the potato plant, but they have come to guard against the nitrogen as increasing the liability to disease. The potato seed growers there are particular not to overfeed their plants with nitrogen ; they say, if they do, the crop resulting from that seed is more liable to disease. This has not, however, been as fully demonstrated as it should be. Scotch growers, the best seed potato growers of Europe, wish to have their seed "lifted," as they say, before it is ripe. They also have a preference for seed not only from a certain type of soil but of a certain size ; and they always wish it to be northern grown, believing that to have superior disease-resisting qualities. I believe we are only at the beginning of the understanding of the relation of fertilizer, soil and seed conditions to diseases of potatoes.

Professor Brooks. There was one point that I didn't speak of, which will take only a word to present. The professor has told you of the presence of the green leaf-coloring matter ; we find the potash salt has a marked effect upon the coloring of the leaf. The shade of the leaf differs, showing a different amount of coloring matter. We find the use of sulphates means more starch, and the use of chlorides means less ; and, while we have no proof that there is a different effect due to all the different potash salts, yet I rather suspect we will find something of that sort later on.

Mr. A. H. Smith (of West Springfield). It has occurred to me, relative to Professor Brooks's statement, that growing plants to their most perfect form is the best insurance that the ordinary farmer could have with reference to these diseases and troubles. We have been raising a few acres of potatoes yearly, and it has been my aim to get the land in as good condition as possible for potato growing, to change the plot yearly, and to dig the potatoes as early as the price in the market would warrant; and in that way we haven't sprayed potatoes. I think perhaps I bought the first spraying machine that was brought into the valley, principally, though, for the purpose of controlling a celery plot rather than a potato plot. I haven't used it on potatoes at all, but have been able to put a fairly merchantable potato on the market at an early date, and get my profits, and let the other people do the spraying. We have this summer had considerable trouble with celery blight, yet I haven't taken out my spraying machine; I haven't found yet that the additional expense warranted it. We raise sixteen to twenty acres of celery, and we had a great deal of the blight in August, but one or two pieces on new land escaped. The growing of a good crop, it seems to me, depends on the proper condition of the soil. It has been my aim, more than any other small grower in the valley, I think, to change the plots. We had one or two of the best pieces I have ever seen in western Massachusetts, and as good a piece as I ever saw, but that was on land that was heavily manured for a number of years, and never had celery on it. There was no appreciable blight on that piece. I looked at the celery around Worcester late in the summer, and I also saw some good pieces there, — I think perhaps they had less blight than we in the Connecticut valley; but our crop, taking the immediate vicinity at large, was badly hurt by the blight. I would like to ask the professor whether in his experience there was any remedy for this troublesome celery blight that comes in dry weather.

Professor Jones. It would be unwise for me to attempt to advise a man of Mr. Smith's experience in celery growing. Practically no celery is grown in Vermont, and we have carried on no experiments with it. Of course you are familiar with the statements of those who have experimented, that proper spraying will control celery blight; and I have seen this done, but on only a small scale, and under conditions not comparable to yours. I certainly approve of Mr. Smith's general point, — that in growing any plant the first aim should be to grow it under as nearly perfect soil and cultural conditions as possible; by so doing, a large proportion of the maladies are forestalled. But, having done this, I would use the spray pump where necessary to insure the perfect crop. Spraying is the last, not the first thing; we build the house first, then insure it afterwards.

I also wish to make myself clear on another point. I fully realize that your conditions of potato culture, with your profitable early home markets, are different from ours. We must get our money in Vermont, in general, from a late crop for the general market. To do this, we find it pays well to spray. This does not prove that it will pay you to do so on your early potatoes; although I am confident that, were increased yield the only thing desired, you could secure it by spraying. With you, a small crop secured early may pay better than a large one secured later. In this, as in all other matters I have presented, you are the ones to judge of their practical application to your own local conditions.

Question. Have you noticed the difference in growing potatoes at higher altitudes and along river banks, — whether the higher altitudes grow a hardier potato, less subject to blight?

Professor Jones. Yes. I have no doubt that good potatoes can be grown along river bottoms, but should prefer to go up on the hillside. Our best potato growers in Vermont are those well up at the higher altitudes.

Question. That would be even more true in Massachusetts than in Vermont?

Professor Jones. Yes, sir.

Question. Then, in growing them in the valleys you are growing them in an unnatural condition?

Professor Jones. Yes. As I stated earlier, wherever we are growing them, we are growing them in an unnatural condition as regards climate; but the higher altitudes are more nearly the natural ones for the potato.

Question. When do you issue bulletins from Vermont?

Professor Jones. There is no rule; sometimes once in two weeks, and sometimes once in two months; the law requires us to issue them at least four times a year.

Question. Do they send them right along on request?

Professor Jones. If you send for any particular one, it will be sent to you. Our station has been obliged to stop the putting of names of outside parties on the regular mailing list, owing to the large demands, and the fact that so many have been found to be missent in that way. But I am sure any particular bulletin you wish will be sent you, if you will write the Experiment Station, Burlington, Vt., indicating what your interests are.

Adjourned.

Afternoon Session.

The meeting was called to order at 2 P.M. by First Vice-President Sessions, who briefly introduced Mr. J. H. Hale of South Glastonbury, Conn., as the speaker of the afternoon. Subject, "Fruits for local markets."

FRUITS FOR LOCAL MARKETS.

BY J. H. HALE, SOUTH GLASTONBURY, CONN.

I have been asked to come here and talk about fruits for local markets. That subject cannot be taken up directly without first saying a word about the general question of fruit production and marketing. A few years ago, in the early days of my attending the meetings of this Board and other agricultural associations, whenever any discussion was taken up, fruit was considered as a luxury, something to be used as an occasional dessert or as a general luxury for the children; but of late years we have come to look upon fruit as one of the most suitable articles of human food, and, as the years have gone by and we have consumed more of it and understood it better, we have come to see that it is the one great source of food supply that comes to us pure and unadulterated. When the fruit is fully developed on the tree or plant or vine, it is in its best possible state for human nourishment, and nearly all our other foods have to go through some milling, killing or cooking process before they are suitable for food; so the good housewife, who wants to be relieved from the burdens of life as much as she can, or ought, has learned that fruit will do away with a great deal of what in the past seemed a necessary making of puddings and pies and pastries. Fruit is being substituted more and more as an every-day source of food.

Then, again, there are no longer "seasons" in fruit. Years ago there used to be a "fruit season" of the strawberry, the raspberry, the blackberry, the apple or the grape; now there are no more seasons. The consolidation of the great railroad lines and refrigerator car service has done away in a large measure with the fruit seasons. We complain of this picking up of the little roads and consolidating them into one big one, but that has had much to do with our increased fruit supply. The consolidation of these roads, so there is one large system reaching to the far west and to the far south, has done away with the local fruit season, so there is no longer scarcely any fruit season at all. The strawberry, which in the immediate location where it is grown covers a period of ripening at the most only twenty to thirty days, now is on the market nine months of the year, — from December until August. And peaches, which a few years ago in the eastern part of the country had a season of three weeks, are now obtainable for seven months. The cantaloupe, once with us but three weeks, is now on the market five months. There are no more short and sweet seasons. The grapes are with us five months, and the good old apple all the year round. So the "season" business has been done away with by the long-distance railroads, refrigerator cars and cold storage.

And people have got into the habit of fruit eating. Habits, whether good or bad, are great controllers of the human race. You get into any habit, whether good or bad, and it is pretty hard to get out of it; and I am glad to see the people of America have got into the good habit of eating fruit, doing away with the bad habit of some of the coarser food products.

Take an instance of the cantaloupe. A dozen years ago the cantaloupe or muskmelon, though grown in all sections of the country where it might be successfully grown in family gardens and for local markets, was not raised for extensive shipping. Of course for twenty or twenty-five years they have been shipping small quantities from Maryland, Delaware and New Jersey to New York and Philadelphia, and from Michigan to Chicago, but there was not a single carload of cantaloupes loaded in one station in any one day in any part of the United States ten or twelve years ago; but the development of a choice variety, and putting it in a good shipping package that would carry it a long distance, which started about eleven or twelve years ago in refrigerator cars, got the people to eating cantaloupes out of season; and last year there were shipped by the railroads of the United States 11,000 carloads of cantaloupes, — that wonderful development of fruit consumption in ten or twelve years on one single variety of fruit. So these railroad lines, and this refrigerator service and these better packages, and this habit of fruit eating, have been a splendid thing for the grower who supplies the local market.

Some people say the local markets are ruined where there is fruit coming in from the west and south. Some of our markets have been held up, on the whole, but the people we reach have been taught to want fruit, and want it all the time, and it remains for the local grower to readjust himself to the local conditions. The thing that seems to hurt him in a way is actually benefiting him. Of course he cannot sell the poor fruit he once did, or fruit offered in an unattractive package; but on the whole he is much better off than ever before, if he will readjust himself to these new conditions. The first big advantage the local grower has over the outsider is that his fruit may be allowed to mature on tree, plant or vine, until it comes to the very highest state of perfection. The grower at a distant point, of course, say 500 or 1,000 miles away, can leave it until pretty near perfection, but must pick it in a somewhat immature condition. The local grower has the advantage of developing it to its highest state of perfection, which of course means the fullest size, the greatest measure of beauty and the biggest price. Many of our fruits add from 10 to 25 per cent in weight or bulk in the last twenty-four or thirty-six hours they are on the vine or tree; and this great advantage will always come to the local grower, who has the still greater advantage of beauty of color, which comes to the fruit in its last development. He gets the highest development of beauty, and also of quality, in the fruit. Having these things, — size and beauty and quality, and less chance of bruising, — he is enabled to get a much higher price than the distant grower. Some grades of fruit brought from within 15 miles of Springfield will bring from 30 to 50 per cent more than if brought from 300 or 400 miles away.

Another advantage, — he may oftentimes sell direct to the consumer, cutting out the jobber and retailer, which means an added cost in marketing; this applies especially to the smaller grower.

I have often had fruit growers in New England say to me, "I grow strawberries; what do you average?" And I say, "Sometimes we get the average and sometimes we don't; perhaps 10 or 11 cents." "Why," they reply, "mine average 15 or 16 cents, by selling direct to consumers." And the same with peaches; they get $1.50 or $1.25 a basket, while mine perhaps average 80 or 90 cents. But I say to them, "How many do you have?" Perhaps one bushel, where I have a hundred, for that is the point. He got two for one because he was raising them on a small enough scale so he was enabled to sell direct to the consumer; but if he were to sell some to the retailers and some to the consumers, he would be up against it, because the dealers don't quite like his doing business that way, and will not buy freely of one who sells in part to consumers.

Then, again, the less cost of packages, generally. Small fruit growers at a distance have to buy new crates and baskets. The local grower has to buy new baskets; but I know a great many who market hundreds of bushels, and haven't bought a crate in ten years. They just get them from retail dealers who have had fruit from the south earlier in the season; 5 cents each is about the price, though they are more often furnished free by the dealer, who hopes to handle the fruit in them later.

Then there are no heavy transportation charges to the local grower. It costs 6 or 7 cents a quart to ship strawberries from North Carolina and Delaware to Springfield, including refrigerator charges; all that is saved to the local grower. The bringing in of outside fruit costs the shipper from one-half to two-thirds the total proceeds of his product. It costs him from $200 to $300 on a light car of strawberries from Southern points, and in the neighborhood of $500 to $550 on a car of Georgia peaches; so the actual cost of delivering goods by distant producers to this or any other market in Massachusetts varies from $200 to $500 a car. And those outside charges more than offset any injury to the local market by outside fruit.

Now, as to Massachusetts soil and climate. We hear a good deal about New England climate, — and Massachusetts, being right in the middle of New England, catches it going and coming; but, knowing something of the climatic conditions of every State in this Union, and their effect on fruit production, I am perfectly safe in saying that the climatic conditions of Massachusetts are as good as the average in America for the production of fruit. The soil conditions here are better than the average in the United States, and of course your market conditions are incombatably superior. You have here in Massachusetts, and we have in all New England, people of appreciation of fine fruits; for the more cultured and refined people become, the greater consumers they are of fine fruits and beautiful flowers and the less consumers they are of the coarser products. I speak of flowers as a fruit product, for they go together. These ladies here know, if they have a sick one in the family and want to nurse him back to life, a little bunch of flowers on the tray that goes into the sick room helps to feed the soul of that dear one. And so, when we put some on the table, what a difference it makes, — we can eat a little less corned beef and cabbage, and have a few more flowers all round. So as to the business question; we are in the midst of the most cultured and refined people of the United States, and therefore in the midst of the greatest consumers of fruit.

Then, they have the money to buy with. Nowhere else in America, or perhaps in the world, are the great body of the common people so abundantly able to buy fruits as they are in New England. The people of New England are a great deal more profitable to feed on beautiful flowers and fruits than in other sections of the country, which I will not mention, as I may want to go there some time; but it is a fact.

All that is wanted, then, to make local fruit production in Massachusetts exceedingly prosperous and profitable, is men and women who are "onto the job;" in other words, who in themselves are lovers of beautiful fruits and flowers. You can't bring anything to its highest state of perfection unless you appreciate it, — enjoy working with it. You have got to put some love in anything to get out the very best in it. So the successful fruit grower must be a man or woman who appreciates and loves these beautiful fruits for their own sakes; then she or he will produce better ones; and the better they are, the more you will get for them.

These people want faith in themselves, in the soil of Massachusetts, in the market, and in the plants and trees. You must be a believer if you expect to win out. If you go into anything in uncertainty, it is pretty sure to be unsuccessful. You must believe in what you are doing, in order to succeed at it. Faith in the soil, faith in self, faith in the fruits, — everything else is here, and there are dollars in it, and a whole lot of them, and then a profit on top of all that.

Now, what shall we plant? That question of "what" opens up a whole wide field. Perhaps you have heard the question of a small Irish lad to his mother, "Mother Murphy, will you have an onion?" to which she replies, "No, thank you, darling; I never eat fruit." That is one idea of fruit. The other day I read a statement made by the Treasury Department; in deciding some tariff matter they were compelled to designate frogs' legs as poultry; and only last week one department at Washington had to decide that "potatoes are fruit;" and these, I think, are in line with Mother Murphy's onions.

Of course there is a whole wide range of hardy tree fruits, as well as small ones, but it seems to me the fruit grower must specialize in a way. A farmer cannot succeed in all kinds of fruit, probably; many farmers wouldn't be situated rightly; many times the men or the women are not fitted for raising all kinds; and many times the markets could be better served with one kind than another. If a man lives in a valley with rich, alluvial soil, like this Connecticut valley, he can raise certain kinds that another man situated back on the hills could not; and, on the other hand, a man might not have the market or the inclination. All these things should be considered; and so it is a local question. Each man must take up for himself the market conditions, the railroad facilities, highway conditions and a dozen other things which enter into the question; but the whole line of small fruits may be successfully grown in Massachusetts, and ought to be. If the money and energy expended in the so-called temperance cause had been expended in increasing the production and consumption of fruits, the saloons would have been driven out of town long ago. Just get a man fond of good American apples and other acid fruits, and away goes all desire for strong drink. Fruit growing and fruit eating make people sunny, sweet and happy; and I am fully convinced that fruit will rule the world just as soon as the Fruit Consumers' League has taken us all in. No one can be full of fruit and full of fight at the same time, and discerning people are seeing it; hence the greatly increasing demand every year for all kinds of fruits in our markets. The land owners who are supplying this demand are making more money out of it than ever before, and are in the way of an ever-increasing, profitable business.

The strawberry is the first we think of, and it should be the first, because in one short year after planting it will come to its full fruitage, and because it will grow in so many different soils and bear freely with the greatest neglect; in fact, it has been called the lazy man's berry. But there are too many inferior berries offered on the market, and they are not profitable. The old-fashioned, thickly matted row system, under which too many of our local cultivators work, is responsible for the lack of success in many cases. More than 75 per cent of all the strawberries in New England are grown on that method, — setting out in rows 2½ to 4 feet apart, and 2 feet in a row, letting each one make the most it will. The worst weed in the strawberry patch is the strawberry plant itself. It will produce from four to ten times, on a square rod, what should be there; and that is a mistake. You must thin out your strawberries if you are going to make any money in that system. You should grow them in hills or in very narrow rows, or grow them in widely matted rows and thin out all the surplus plants in August or September, — perhaps not later than the last of August. Cut out all the plants except what you want, leaving them 6 to 8 inches apart, having a row, if you will, 2 feet wide, and a path or space between them. It looks like an expensive job to go into a matted plot or row, and thin them out. It does cost money and takes time, but it will pay. The balance of the plants will make a heavier stalk, and you will get a greater number of quarts of berries two or three times the size, and that makes a difference of between 50 and 75 per cent in their selling value.

The strawberry needs an immense amount of water. I have seen acres and acres of splendid strawberries grow almost to picking, having had good, heavy rains within a week of the time; and yet, having no more rains between then and maturing, more than one-half was lost, for they did not come up to the proper size, from lack of moisture. This may be remedied somewhat by tillage or thorough preparation of the ground. Since I have been growing cow peas I find that the strawberry land contains more moisture than before. That is one of the ways, — getting some green crops and loosening up the ground, and then the heaviest of mulching during the season, and if you apply irrigation, so much the better. Liberal feeding will pay, but one thing above all others that is most essential is the spraying of the vines with the Bordeaux mixture. Nearly all varieties are subject to this strawberry rust, — scientific men will give you the exact name; but it makes a little brown spot on the leaves, and it spreads, and when you harvest your strawberries it shows on the calyx of the berry. If you spray it twice a year, once in September and another liberal spray early in the spring before the plant blossoms, it will ordinarily act as an insurance policy, or prevent the crop from being lost, which amounts to the same thing. About half of all the strawberry yield is lost where the fields are not sprayed, and no one can afford such a loss as that.

As to marketing fruits, many of you here are past middle life, and remember the early marketing of strawberries in New England in blueberry boxes. Years ago all were marketed so. They cost 3, 4 or perhaps 5 cents apiece in those days; but we packed our strawberries in them, and put on a top cover. Then somebody invented the American basket, and so ventilation crept in. They said, "Oh, we have a glorious ventilated basket;" but it commenced the ruination of the berry. People thought they were doing a great thing in giving the fruit air; but the tight package is the proper receptacle. Did you ever buy any strawberries of the grocer, or the Italian, or the peddler on the street, and notice that, just before showing them to the lady, he turns them upside down, emptying them into another basket, so that what the lady sees comes from the bottom of the basket away from the air, and not the top where they are wilted and faded? After being picked twenty-four hours, the only really bright-colored berries are the ones at the bottom, where no air gets at them. The less ventilation we give the basket or crate, the better, though many a man feels otherwise. Many a man I know has built a little packing shed at the top of a hill and roofed it over, with a table inside. He says, "Isn't this a glorious place, — a breeze blowing through all the time." Yes; and ruining the strawberries. Of course if they get wet you must put them somewhere to get the moisture and heat out of them; but if they can be picked cool and dry, put them in an absolutely tight basket; and if they cannot, put them somewhere to cool at once, and then put them in the tight package as soon after as possible. The tighter and closer a package, the finer the berries will be when put on to the market. That hits the present strawberry boxes and present crate; but I am talking about the fellow who is after the best market the world has. The last few cents on top is where all your profit is coming from, and everything that will help to put that cent there is what is wanted. It is looking after the little last thing that pays.

Now, to branch off a bit, — in knocking about the country, as I have to do in my business, I stop at hotels and dine on dining cars, and eat on the run here and there, everywhere; and I visit my city cousins occasionally, — they sponge on us in the summer, and we have to get back on them, — and I hear everybody telling there is no more sweet corn. "Why, when I was a boy we used to have sweet corn, but now they don't grow any more, — they grow white varieties now; we would buy quantities of sweet corn if we could only get it anywhere." The farmer grows just as good sweet corn as he ever did; but the fellows talking live in the city, and they, as well as the men dining on the dining car or at the hotel, have to take corn that was picked yesterday morning, perhaps, and put in a barrel and transported somewhere, and sweat all out. From the minute that corn came off the stalk the sugar in it was turning into starch.

This is a little off of fruit culture, of course; but I speak of it as it is in the same line with these berries. By getting them ripe and in perfect condition, and keeping them sealed until ready for use, we will have "the kind that mother used to make."

But to go back to the corn just once more. If I were going to do a family trick, if I were near the city of Springfield and my business was in the vegetable line, I would see all the leading families; I would get next to the man or the woman of the home, and say, "Don't you want some good, sweet corn at 3½ cents an ear? I will deliver it at your door." I would get just as many of those orders as I could, and then, if I had to go down to where Mr. Lawson sold his horses last Saturday and buy a fast one, or buy an automobile, I would pick that corn between 9 and 10 or 10 and 11 A.M., and deliver it to their homes a little before the pot was boiling. I would force them up to 4 cents, and then I would force them up to 5, — and they would pay it, too. It is simply applying business principles; deliver the goods and you can get the money. People want *sweet* corn.

And it is the same with the strawberry. Let it get ripe on the vine, and then get it to its destination just as near perfection as you can. I have samples of strawberries sent to me from different parts of the country to test; and I find when a man picks them and wraps them in a wad of cotton, over and over, until there are a dozen thicknesses, and four or five thicknesses of paper besides, and sends them to me, the strawberries are the best. If I don't want to test them Monday, being washing day, I don't have to; Tuesday is coming; or I needn't look at them for a week after that, and they are sound, beautiful berries; I have kept them twenty-one days, away from air.

Now, as to the varieties. That is a local question, in a way; but there are a few better market varieties than others, and they are worth considering. You will have to work that out very largely for yourself. For extra early, there is the Climax, the Fairfield; and for midsummer the old Haviland, Glen Mary and Sample; for middle late, the Mead; and the Stevens Late Champion for a very late.

I didn't say anything about the soil. They will grow on almost any soil, but a strong, deep, moist loam is best. Keep them off the sand and gravel. They are grown on a very stiff clay, but the profitable ones grow on good, strong sandy loam. A very stiff clay is the least desirable, and gravel; these are the two things to avoid, but anything between them is good soil for strawberries.

Raspberries, both red and black, need the very strongest and best land you have on the farm, for profit. Land that will grow your very best English grasses to perfection is your best raspberry land; land that will stock right over with timothy, blue grass and red top and things of that kind is perhaps the best. It pays to be liberal with the raspberry, and it doesn't pay to plant them too closely. Seventy-five per cent are planted too closely, sometimes in hedge rows not more than 4 or 5 feet apart, and the plants allowed to be grown too thickly. Another thing, — pinching them back, when they are 2½ to 3 feet, pinching off the main stem, which causes a large number of side shoots, and inclines the plant to be overloaded; you get an overload of small, inferior fruit. The finest results I have ever seen have been brought about in two ways; one is in hills not nearer than 7 and sometimes 8 feet apart. Looks like a long distance, and is; but if you give them a liberal degree of culture, and give them 5 or 6 feet stake, you will then get a great hill about 3 feet in diameter, with hardly enough room to walk through, — providing they have been liberally fed. On the Pacific coast and some sections of the middle west and southern States, instead of putting in stakes, they are putting in posts perhaps 20 to 30 feet apart, and stretching one single wire about 5 feet high across, and when the cane becomes tall enough they tie the tip of the cane to it. If it goes further, it wants tying down a second time, one cane about every 8 inches. The finest raspberries grow out near the end of the cane for there they get the light and air. A great many times people want to cease cultivating their raspberries early, and, although they ripen early and ought to be hardy, there are some diseases of the foliage of the raspberry, and oftentimes, with a cessation of the culture and a little disease on the foliage, they will drop. They ripen and will pull through all right this year, but in the spring they are all dead; and the neighbors who kept up their culture later, kept up a vigorous growth and a good, vigorous foliage on them until October or even later, find their raspberries come out better in the spring. It practically pays to cultivate the raspberry late in the season; keep it growing, apply more nitrogenous fertilizer, if you will, after bearing, and it will give a healthy foliage late in the season, and that means good vigor to stand frosts of winter and come out alive in the spring.

Raspberries are profitable, because they will stay a long time and keep bearing year after year for eight or ten years. The strawberry wants renewing nearly every year, although some varieties will fruit better when two or three years old; but the raspberry will yield just as well when five, six, eight, and perhaps ten years old, and is therefore more profitable because renewal expenses do not come often.

We are using more and more the quart basket to market that delicate and very tender fruit, the raspberry, in, and it is a great mistake. If you put them in a quart, and jar them a little, every one will settle, — and the people who buy them won't settle. The profitable days of the red raspberry along the Hudson River were when they used thirds and pints, but there has been a tendency to do away with the thirds and pints and market entirely in quarts. I think it a serious mistake to try to deliver the delicate raspberry to the consumer, either direct or through the jobber, in large packages; better put them in small packages. And the same cooling wants to take place as in the case of the strawberry, and, in fact, in the case of all small berries.

The blackberry may be grown profitably on a much lighter soil than either the strawberry or the raspberry. While it needs moisture, it seems to root deeper, and can get more from the soil. It can be grown over a wider range of territory than the raspberry, because it can be grown so extremely high; it can be grown in valley lands, where the frost would kill raspberries entirely; and on high land, too, and will obtain moisture. Prior to a dozen or fifteen years ago blackberries were the most profitable of all our small fruits, and they began to be less in demand; and of late years for a time the early peaches from the south seriously interfered with the sale of the blackberry, and there was quite a dropping out of the blackberry in the market, until people began to get hungry for them, and they were brought from the south, and then the local growers started in growing them again, and to-day there is nothing in small fruit culture that has more promise of profit than the blackberry. It is a splendid opening. It can be grown with moderate expense, and you can increase it with the same methods as applied to the raspberry. But you want the right variety. Some of the biggest, which look the best and sell the best the first time, won't sell at all the second time, because too sour. Some of the varieties begin to turn red as soon as they are picked; then some of them grow sour, and they are disappointing. But there are a few kinds that will stay black after they are picked, and are of high quality, and the people will want more and more; and they can be marketed in quarts.

Currants and gooseberries: gooseberries will grow almost anywhere in New England, if you give them a fair chance, and if you live in a town where there are English and Scotch people you can grow them to a profit; but Yankees and Germans don't seem to want them very much. They are very profitable indeed where you have the market, because they can be grown for such a small cost, and yield so enormously; rather prickly to pick, but profitable. As for currants, there isn't one-tenth enough currant bushes in Massachusetts or New England to-day to supply the people, and yet ten years ago there were too many. People didn't want them all then, as they want them now. Then there was an overplanting, an oversupply twenty years ago, and the price went down, and currants disappeared; but now there is a splendid market for local or Boston growers. They need spraying to strengthen the foliage; and Bordeaux mixture seems to be one of the best things to be used, also the lime and sulphur mixture, and can be used on the currant; also for the scale which infests our trees, and doesn't infest our other small fruits except the currant and gooseberry. All small fruits need an excess of moisture at harvesting time, and where irrigation cannot be practised, very liberal cultivation early in the season and heavy mulching through the fruiting adds greatly to the profits.

Grapes: to talk to a Massachusetts audience about planting grapes commercially might seem somewhat surprising, because you now have tons and hundreds of tons coming in from outside States to supply your wants. I don't suppose a one-thousandth part is grown in Massachusetts, and yet you can grow just as good and just as fine grapes in Massachusetts as any that are now selling in your town here to-day. You can grow them just as cheaply and you have just as suitable land for a few of the standard varieties of grapes as anybody in the country. Perhaps you are doing a more profitable business; perhaps you can't afford to grow a basket of grapes for 8, or 9, or 11 cents, as our friends in western New York and Ohio do; but if you haven't a business better than that, you can do it as well as they. On the other hand, there is an enormous and increasing demand for grapes for wine making. Some of you ladies will say, "We don't want any wine made in our State;" but if you could have more good, pure, native wine drunk, and less poor gin and beer, it would be better for the State as a whole. Our incoming foreigners — they are coming here from Italy largely — use grape juice or wine as one of their sources of food supply. They have been brought up on it for thousands of years. Their children drink wine for breakfast, dinner and supper, and do not drink the poison tea or coffee. Your children cry for tea and coffee, and you fool them with "cambric tea" for a while, and a little later you put a little more tea and coffee in, and gradually increase it from time to time, and by and by they come to be the same old coffee topers you fellows here are. These foreigners are not drunkards and seldom become drunkards; but it is one of their sources of food supply, and they are going to have it, and if they are going to get it from Massachusetts grapes, so much the better. If they have to send to western New York, they will do so; if they can't do that, they will buy the wine in Italy or California. With no special ideas of temperance or intemperance, those people are going to use, as a wholesome, healthful food, — and make no misuse of it, — the juice of the grape. You can go on your warm, sandy hillsides and make a success of growing grapes to supply them. A few of the best standard varieties can be profitably marketed as a dessert fruit, but the demand for grapes in bulk, as I say, for wine making, is increasing so rapidly that it is making a large and profitable market for grapes that may be easily and cheaply grown on many fields that are now otherwise practically worthless. You can grow from 5 to 8 tons of grapes per acre, and sell them in your local town, if there are enough foreigners there, as high as $50 a ton in bulk for wining. And we buy coffee for 40 cents a pound! While I am not a drinking man, and believe in temperance, yet I say and think they are doing better for their posterity and themselves than we who drink tea and coffee, and allow our children to follow us. There is a big profit in this work now, and it is growing all the time.

The next profitable fruit is cherries. All or nearly all the trees in Connecticut are dead or dying, and I expect those of Massachusetts are also. Nobody on the farm has cherries for the market. The people are crying for cherries. As a whole, the consuming public cherishes the taste of cherries, and is hungry for them, and wants you to grow them. They will pay for them, and pay enormous prices, too. There is a splendid chance to-day for the one who first develops new orchards of moderate size to fill this want, — sweet to eat, and sour for cooking. There is a profitable market in Massachusetts to-day for the product of from 25,000 to 50,000 cherry trees. You say anybody can grow sour cherries, but the "sweet cherries all die;" and it is true. It is true because the nursery men have for years been growing them on the imported stocks, which are easier to grow, but not so hardy, and he wants the easiest. For some reason or other they don't like our soil, and are dying out all over the northeastern part of the United States.

With the sour cherries you get a strong root system, and get a hardy tree. If you get the hardy trees, there is a glorious opening for sweet cherries in every market of every country town. Why, the farmers of Massachusetts want to buy cherries! I don't believe there is a family in Massachusetts that would sell their cherries at any price, even to their nearest neighbor; why, they want them themselves. And so it goes on. Get sweet cherry trees that are budded on Mazzard stocks.

Then peaches: you hear about what you can't do here in Massachusetts, but you can grow peaches profitably in every county in the State except most of Berkshire, and in some sections of Berkshire you can grow beautiful peaches, and you have got men within 10 miles of this hall growing peaches as fine as are grown on the earth, and I suspect they are doing well financially. Somebody will say, "Yes; but they have thousands and thousands of acres in Georgia and Texas, from which they deliver here." Yes; but they are not the ones allowed to ripen to full maturity. Every town in Massachusetts has people who want to buy peaches; and no matter how many they have had from the south, or how many months they have run over, they will buy yours from you right fresh from the tree. Don't plant them in valleys or on wet land, but on the hills. By taking your semi-elevated hill land, not too dry or too wet, and thoroughly tilling it and planting a few varieties, you can cover the season and deliver the fruit to the grocer, or the wholesaler, or the family itself, for more than two months, or about that, and find it profitable. You must have the trees headed down low, as this San José scale has forced you to spray all your peaches and other fruit trees. You want the tree as close to the ground as possible, so you can work over it. You will need to thin your fruit, and you want to harvest your fruit; and if it is a low-headed tree, you can do your work and save 50 or 75 per cent of large fruit. The thinning of the fruit will result in more beautiful fruit, will result in larger fruit, will result in a higher-flavored fruit. Some people think a peach is a peach, and will take a standard variety and think it is going to be the same, whether there were 10 or 1,000 on the tree, but it is not. The quality is wonderfully changed by the amount of fruit you allow the tree to bear, and the color is also affected by it. So thinning the fruit not only increases the size, but the beauty and the quality, and that is what your consuming people are going to pay for. It is the only way to get the top dollar. It takes the first dollar to pay the rent of the land, and the next two or three for the labor, and the next dollar or two for the fertilizers, and another dollar or two for the spraying, and something for the packages, and then the harvesting and taking to the market; and there isn't anything for the grower until you get at the top, and all you get on the top means business and profit, and for the women Easter bonnets and all that sort of thing. I grow peaches in Georgia on quite an extended scale, shipping to the different dealers. We will assume a price of $1.50 a crate. Some dealers, rather than lose a trade, will drop the price to $1.40. They say, "I was only 10 cents below the other fellow," but that 10 cents was all there was in it for me. The difference didn't look big, but it would pay 13 per cent dividends on the capital stock of our company on that crop, and that is a big dividend. So to the grower the last cent you can put on the top of a basket of peaches or strawberries is the funny business. It is that which spells profit to the fruit grower. It is all the fun you are going to get out of it; and it can only be had by spraying and thinning and careful handling and nice packing. Whatever fruit you put on the market wants to be the same top and bottom and all the way through all the time. Not that you are any more honest than we are in Connecticut, but that it will develop and hold trade and pay, — that is all.

Plums: these incoming foreigners that want so much wine making also are great lovers of plums. Up to the advent of the Japanese plums twenty years ago there were scarcely any plums used as a dessert fruit, and they were used for canning and preserving but very little. But the advent of the Japanese plums has brought the consuming public to eating plums very largely. The Japanese plums are extremely short-lived but hardy trees, and, properly handled, they are another profitable source of farm production. A few of the European varieties are good also. The German prune, for instance, is a hardy variety. And you can market the plum when you please; market it to-day if convenient, or next week if not, or even the week after, and it is still in sound condition. Then it is a very delicious cooking plum, and is in very great demand.

Pears you can grow in eastern Massachusetts better than in any other part of America. No finer pears can be grown anywhere in America; other fruits they can grow just as well, but not pears. But are there any new pear orchards in eastern Massachusetts, grown in local gardens? A little. And yet they bring in pears by the carloads from the Pacific, and they are not as good as the native fruit. There is a splendid market for the Bartlett and the Seckle and the Bosc. You can market them over quite a season. The shipper doesn't care what the supply of the local market is; he wants something that will have a long season, so he won't be doing a big business one day and then drop out of it entirely the next. There is money in it, and you can find that out by simply asking the tree on your neighbor's land. I know from Worcester east is the particular pear section. They used to give them pretty good care a number of years ago, but it is "go as you please" now.

But the really good old money-making fruit in New England is the apple. It will grow in your valleys, luxuriant-bearing trees, free-bearing trees, but you don't get high quality and color. You have got to go to the hills to get color and quality; but the hills back and across the State in the high lands, is where you can grow beautiful apples in Massachusetts, and the people want them more and more.

Away back in the early days your Horticultural Society of Boston has in its records the early history of the apple planting in Massachusetts; and you know in early history it was entirely the planting of apples to get something to drink. Those dear old Puritan fathers were a lot of old topers, as compared with you temperance men of to-day. The one thing they did in their last fifty years of orchard planting was to make something to make drink from. I presume

Mr. Ellsworth's honorable ancestors wouldn't have thought of pulling through the winter with less than 100 barrels of cider in the cellar. I know one of your colonial governors with one of ours in Connecticut were comparing notes on board a vessel crossing the ocean. One of them had 500 barrels of cider in the cellar, and thought his family would pull through till spring. As I say, the early planting was done for the purpose of cider making; and in later years the apple was used for cooking, making pies, and the boys ate them, and the old men, for the sake of the fun of throwing the parings in the fireplace, but as a food specially they were not largely consumed.

And in recent years we growers have done all we could to stop that consumption. We have grown them carelessly and put them in a tumbling barrel and sent them somewhere. The packages were so big the people didn't think of buying them as a whole. They could hardly take a barrel home by hand or on the car. When they bought any of the grocer, a portion was poured out of the barrel, a peck, or more often half a peck, and the apple pie was made, and the children ate the rest, and no more apples were bought for a week. While beautiful apples can be grown anywhere in Massachusetts, the finest apples in your town to-day were grown 3,000 miles away, because you were too pesky lazy to get the rough off. They are selling here for about $3 a bushel in boxes, but every apple is perfect, and native apples are bad in appearance. You get $2 a barrel, because you do not finish them up as they do on the Pacific slope. But when you wake up and manufacture the kind of apples that your soil factory is able to turn out, if you will apply the right sort of skill, the right sort of treatment all the way through, and put them on the market, why, these people would just as soon have your apples in the boxes as those from Oregon.

But you want to go further than that; you want to grow the beautiful summer and fall apples of the highest color and quality, and offer them in your towns in small family packages, something after the style of grape baskets, or what you will that is light and attractive, and see the result. Look at the baskets of grapes, — the grape men have made them handy to take home; and if the apple men will put their apples in a family package, and make it easy for the people to get them, they will have demand enough; for now that we have become a nation of fruit eaters, the apple has greatest chance of all.

We must have in the apple just the same sort of a tree as we have in the peach. The old, long-shanked apple tree must go. You can't get to Heaven that way, for you can't spray such high trees. Every apple tree will have to be sprayed thoroughly, and there must be some pruning and some thinning of the fruit every year. The markets are here, the people are here and the money is here, and they want the apples; but the man that gets that money must thin his apples, and to do this economically he must have low-headed trees. You must get the tree down, so you can look it over to prune it, spray it, thin it. Then you must do another thing, — when your apples are mature, you must pick them as fast as ripe. And as to picking the apples, — you who grow peaches don't go out and strip every peach off the tree at one time; you go and pick just the ripe ones, and again you go in another few days and find some more that are mature, and so on. Or tomatoes, — the children come in and say, "Mother, a tomato is ripe." Do you go and strip them all off, ripe, half ripe and green all at once, or do you let them stay and ripen? No, you don't pick the ripe and green ones together, — not a bit of it. But that is what nearly every man in Massachusetts does with his winter apples, — goes out and cleans them up at one time; some lay on the ground rotten, and he picks what is left. The man who makes money in the future will pick each set of apples when they are ripe. Somebody says that means work. Certainly; but there is a fellow right here in Springfield and Boston and everywhere else, who wants to pay you for that work, and he will pay you, and give you the profit on top of it.

Now, the early apples and the fall apples may be picked and marketed from day to day. Then come the winter apples, which we must carry for four or five months, and that means harvesting when they mature, and immediately putting them in cold storage. Just the minute the winter apples mature on the tree, each wants to be harvested and go straight into cold storage. Then the small grower says, "I can't afford a cold storage house." That is true; the smaller grower cannot, but every neighborhood could, if farmers would co-operate as other men have to do, or fail. These banks here in Springfield have to work together, and the manufacturers have to, or the tariff might cut down their profits; they dig in and work together, and make us pay it. The fruit grower, to get the best profit, will have to have a business big enough to own a cold storage house, or a soul big enough to co-operate with his neighbors and have a co-operative cold storage house.

Now, the selling problem of all these fruits. The selling problem is the big end of the business. We may have as fine a product as can be found anywhere, but if we do not get on to the selling part of it, it is a loss; and it is the business of the farmer — of every man, but specially the farmer — to succeed. Judicious advertising pays as well in fruit marketing as in any other line of business. Just what form of advertising you take will depend on each man and the location; but with a local market, which the grower is going to reach with his own teams, the team and wagon itself should be well painted and always clean, with a good lettering on it, — the name of the farm, the name of the grower; and the horse should be a good one, and he should have a well-dressed driver. No long, lanky farmer or salesman, poor and raggedly dressed, whiskers needing cutting for two weeks and hair two years! It is bad advertising for any fruit. It is essential that the driver, whether the owner himself or the man he sends to market, should have a gentlemanly appearance, and a clean, attractive team; it is part of the business. The clothes won't cost him anything; the fellow down town will pay for them. Any frills I put on to business I would make the other fellow pay for in the higher prices of fruit, because he is tickled to do it if the fruit is perfect and the best of its kind. Any lady would rather pay a little more to a neat, attractive driver and wagon and harness, than she would to a filthy, broken-down wagon and a poor, dirtily dressed man. It's business. The best advertisement for the local grower is being "a good looker" in his business.

Then advertise by putting a label on every package of stuff you sell, stating what the variety is, what farm it comes from, or any other information that seems essential to telling the people about your goods in as glowing colors as you can and yet stick to the truth. Put in circulars with instructions how to cook, anything that will help encourage greater consumption of your fruits. That is your end. It is astonishing what a retailer can do to develop the consumption of fruits by the proper display. Take my own local city of Hartford, and take New Haven, — Hartford nearly 90,000, and New Haven nearly 130,000. In Hartford there are three or four grocers who have made a specialty of displaying their fruits in a most attractive manner. They have hired fruit experts who don't do anything else but show the fruit. They are making a beautiful show. The ladies go over and look in the window, just as they do in the millinery store to see the bonnets. Hartford in the last five years has sold $3 worth of high-grade fruit to every $1 of New Haven's, simply because a number of the dealers have made a display, and are showing the people what they have and tempting them to come in, while New Haven has not done as well.

Your wholesale men in Springfield for a number of years have been advertising the products that are coming. To-morrow morning, I presume, you will find an advertisement of what the jobbers in Springfield have to offer. The people reading the paper will see strawberries on the market. Mary is going to have a little party, and you ask the grocer if he has those strawberries. No; but he guesses he will get some, and he does. So the retail man who advertises in the paper creates a demand for the goods.

But the grower, if he is seeking to sell at retail, should use the local press to advertise his goods. Keep the people talking about what is going on. They will pay the bill in the end; you can put it on the price of the goods. Make your place attractive. Plant as many flowers as you can. Occasionally invite the people to come out and see. Wouldn't do any harm if you informed the whole population of a time to come out and eat strawberries and peaches. You get in touch with them, — a personal interest; that counts. After that they will buy your stuff before others.

Do you know, gentlemen, if you should go down town to-morrow, and your wife told you to buy some oatmeal, what you would buy? "Give me some oatmeal," you say to the grocer. He wouldn't dip it out of a barrel and weigh it up, a pound for 3 or 4 cents; he would give you something in a package that you pay 5 or 6 cents a pound for. The National Biscuit Company spends $1,000,000 a year to induce the ladies of this land to buy a lot of wrapping paper and a few crackers; six ounces of crackers in the Uneeda Biscuit package, and you can buy just as good biscuit in bulk for 8 cents a pound, if you know how to buy them. But the ladies of the land would rather have them that way. That is all right. They are paying the bill, — or the old man is. So the company puts out $1,000,000 a year to induce people to buy wrapping paper in place of crackers. The goods are all right and it is a nice package, but it adds tremendously to the cost of the consumer and enormously to the profits of the producer, — and I am after the profits of the producer of fruit. There is money in every local fruit market in New England, gentlemen, if you will only tackle it on business lines.

Mr. AUGUSTUS PRATT (of North Middleborough). Won't you tell us something about dwarf apple trees?

Mr. HALE. I know very little about it from practical experience, and I question its profitableness. I have seen some small orchards in the vicinity of Rochester, N. Y., and also on the grounds of the Agricultural Experiment Station at Geneva, N. Y., and up at Amherst. It makes a mighty nice little plaything for the family garden, if you want to see a variety grow, and get next to it; but for a business proposition I think you better use the standard trees, and prune them.

Mr. PRATT. Another question; have you any newly discovered remedies for the San José scale?

Mr. HALE. Nothing very new; spray thoroughly with the lime and sulphur mixture, and it can easily be controlled.

Mr. E. CYRUS MILLER (of Haydenville). There is a fruit that has long been neglected, and personally I would like to hear from Mr. Hale something about the quince.

Mr. HALE. The quince is such a slow-growing tree, and is infected with so many diseases, and I have known so few people that have succeeded with it profitably, that I hesitate to recommend it. I think quinces might be grown on heavy, moist soil, — not wet land, and not much cultivation, but heavy mulching. But I wouldn't recommend anybody to go into quince culture on any extended scale, with much hopes of finding it profitable.

Mr. JOHN W. CLARK (of North Hadley). Our friend spoke about the dwarf trees, and I would like to have Mr. Hale tell the audience how we are going to dwarf these tall, sky-scraping apple trees we have, and bring them so we can handle them; and how to grow dwarf low-headed orchards.

Mr. HALE. To start the story the other way to, and take the young trees, we can buy yearling trees that have a whip, and cut them down to a foot or 8 inches from the ground, and let them head from there. That is easy enough. But the old tree, I would dwarf it with an axe close to the ground, and burn it up, and plant a new tree; but that means eight or ten years with no fruit. Another way, if we don't mind the looks of it, — a top tree is pleasing to the eye, and a fruit grower who loves his profession would like to see a good-looking tree, — but if he takes these old, long-shanked trees, not too old, say from thirty to fifty years old in New England, and saws the main top off down to the lowest tier of branches so that some are left on all sides, and paints over the cuts with two or three thick coats of white lead paint, — which is the best thing to cover a big wound or a small one, — each branch left will begin to give new bearing wood, and as the years go by you will get a squatty, flat-topped tree. Cut off the new upward young shoots from the middle of June to the middle of July, which will check that upward tendency; if you prune them well, those trees are right to bear the second year.

Mr. Clark. When would you do this?

Mr. Hale. Any time when my axe was sharp, and trees in the dormant condition, never later than early April.

Mr. Clark. Wouldn't there be quite a good many apples on the ground from low-headed trees?

Mr. Hale. Yes; the low branches, of course, would go down. There would be that objection, but there are objections to everything. You lose some fruit, and the temptation is to shear those off, so as to get up close to the tree in culture, but don't do it; you must thin, spray, prune and harvest; and to do this best, the trees must come down to the ground. The old tall trees are bound to be superseded by the low-headed ones.

Prof. F. Wm. Rane (of Boston). This is a question that I am highly interested in. I am setting out apple trees in my native State of Michigan, and before going into this, this was a point I thoroughly believed in, but the last year or two I have been inclined to think just the other way. I am inclined to think it is going to prove a mistake if we start the trees too near the ground. We have one noted example in Peterboro, N. H., where the man takes care of his orchard to the pink of perfection in every way, and not only sprays and prunes, but feeds the trees, and has carried everything out beautifully; but when I was there this fall, when they were picking apples, lots of them were on the ground, and you had to lift the limbs to get them; and the trees that were doing well necessarily had props all through them. Of course there is individuality with every tree. I think it will depend largely on the nature of the tree itself; some trees will stand upright, and have more or less the tendency to hold their fruit high; on the other hand, some trees have a natural tendency to lie on the ground, although the head be very high. In looking into that question two years ago, I made up my mind that one of the things necessary was to get a tree pretty high. I visited a great many of the western New York orchards, and talked the matter over, and I believe why they went high was because they wanted to cultivate in the orchard and raise other crops; and, while that is a laudable object, I didn't look at it from that standpoint.

I cultivate for the benefit of the trees, but I thoroughly believe, if we go too close to the ground, we are going to make a mistake.

Mr. Hale. It is true about losing the fruit from those low branches; but there isn't a high tree in America but what you lose enormously in the upper fruit, and I believe there are more apples lost from the top of the high apple trees than from the low branches of the low apple trees. You are bound to lose some, either way. What troubles me is, why you want to go to Michigan and plant apple trees on that flat, low country, when you had such glorious hill-top orchard lands in New Hampshire and Massachusetts. The mere fact that you did that proves you unfit to control an apple orchard.

Professor Rane. If we Michigan men can afford to raise apples in southern Michigan and ship them to Boston and make a success of it, why shouldn't we do it? I was born and raised in southern Michigan; it is my native home; the old farm, the environment we have heard so much about, is there, and my heartfelt sympathy goes back there, and I naturally keep Michigan close to my heart, although I have been in New England eleven years, and believe thoroughly in what Mr. Hale said this afternoon, — that the apple crop can be grown all over this State and up in New Hampshire to great advantage. I think perhaps that will answer in a way the question Mr. Hale asked me.

Mr. Hale. I am mighty glad I asked it that way. He brought out just what I believed he would. He loves the place where he was born. The place in Michigan where he was born is dearer and better to him, and will bring better apples for him than anywhere else on the face of the earth. That is what makes a man; that is what makes a citizen; that is what makes an American. I always liked him; now I love him, because he loves the good old place where he was born, the home farm; and if the boys who had been born on New England farms had just such feelings as that, or if those farmers who bred boys on New England farms had taught them the same feeling, the love for the home, the love for the farm, we wouldn't have the boys going out of the country to the city, but back to the soil. You will grow better apples on that farm in Michigan than on any land in Massachusetts or New England. It isn't a quarter as good for it, — and you know it, — but God bless you, you are going to try and do it there, and you will succeed.

Mr. E. P. WILLIAMS (of Ashfield). How tall should we allow a tree to grow?

Mr. HALE. I wouldn't want a tree, when bending with fruit, to be more than 12 feet to the top, and would rather it would be not more than 8 feet.

Mr. WILLIAMS. Well, how will you get any fruit close to the ground?

Mr. HALE. You go up on the hills and you will be able to, away above this low ground. Get up into the pure air; climb the hills. I want my tree close to the ground, and for the other advantages I get I am willing to risk the loss of some fruit on lowest branches.

Mr. WILLIAMS. The low limbs is where we get all the second-quality apples. I don't want an apple tree too high, but I like a tree that it takes a twenty-foot ladder to pick.

Mr. HALE. I can't afford to fool with that kind of tree. It costs too much to prune, spray, thin fruit and finally harvest it.

Mr. WILLIAMS. You can't get good apples if you go to the top of the mountain, — if you have those low-head trees.

Mr. HALE. That doctrine has made the majority of the people of New England say that apple growing doesn't pay. Now, you are a good, honest brother, and I know you mean it, — but it isn't so, just the same.

Mr. WILLIAMS. How many apples do you get off that tree?

Mr. HALE. I didn't get heavy into apples until within the last ten or fifteen years. If I had known what I do now when I was a boy, it would be the millennium for me now, I have some old, high-headed trees, though, and the yield is 8 to 12 barrels per tree.

Mr. WILLIAMS. I want to find out what you get; I wouldn't give a cent for a tree that wouldn't bear more than 10 or 15 barrels of apples.

Mr. HALE. Oh, pshaw! You want to do better than that, and I mean to, when my low-head trees get twenty or more years old.

Mr. JOHN BURSLEY (of West Barnstable). Will Mr. Hale name, if he can, without divulging his own business too much, two or three blackberries which we can grow that will be a little sweeter, and will not turn red?

Mr. HALE. One of the sweetest and best, that hasn't rusted with me at all, is the Eldorado. It isn't quite as large as the others, but if I want to sell direct to the consumers, it is very profitable indeed. The Ward is really a seedling of the old Kittatinny that went out on account of that rusting. Those are the two best. I think perhaps now, if we spray them, we can get rid of that rust.

QUESTION. How about the two varieties of peaches grown in Georgia, — the old Champion and also the Francis peach?

Mr. HALE. The Francis is a great peach, evidently a cross between the Elberta and the Crawford; a vigorous tree; buds are quite hardy; it is a profuse bearer, but it is inclined to rot at the least provocation, which is something rare for a peach ripening so late. Sometimes it will be red on the sunny side, and the shady side, which should be yellow, will be a dull, greenish yellow. It is a valuable peach, but much inclined to the brown rot. The Belle of Georgia is perhaps, taking it on all sides, the best white-flesh peach there is in America to-day. It is extremely hardy. It is a large, white-flesh peach, sweet and delicious, sometimes a little bitter, — that is the one out about it; but the best are extremely hardy, and will stand winters. But to compare it with the Champion, which precedes it about a week in time, — the Champion is a profuse bearer, sweeter, more juicy, doesn't have any of the bitter taste, and is cling-stoned. If I were to take one peach in America to eat, I would take the Champion peach; but it is so inclined to rot, it is risky, — it is uncertain.

Mr. JOHN W. ADAMS (of Springfield). We are troubled a great deal with spots, what you call railroading. Mr. Hale told me some time ago he didn't know any positive remedy; I would like to know if he has learned something since then on that subject?

Mr. **Hale.** Well, I have learned some things, but I don't know as there is any real remedy except to pick and burn every poor specimen, — everything that drops from the tree. In this way you will get rid of the breeding of it to some extent, but there is no remedy found yet to fight it scientifically.

Prof. **Wm. P. Brooks** (of Amherst). I haven't a question, but I want to say a little something in the way of emphasis; perhaps it is rather presumptuous to do so, because Mr. Hale seems amply capable to defend his convictions. We have heard lots of words of wisdom from him, but to my mind none better worth remembering than the statement that no man should go into a thing with the hope of succeeding, unless he loves it. That reminded me of a bit of experience. A number of years ago I went up to northern Worcester County to lecture at a farmers' institute. After a long sleighride on a very cold day, I arrived just at noon, and drew up to one of these little Florentine stoves which they have in country houses. I hadn't begun to thaw out, when a gentleman standing there began to talk about raspberries; wanted to know if we raised any raspberries in Amherst. I said yes, a few. Then he wanted to know if we found anything new. I had to confess — I am a modest man — that I didn't know as we had. He said if we had, he would like to come down. He lived in New Hampshire. Here endeth the first chapter.

About two years ago I was invited to go to southern New Hampshire to lecture. The railroad accommodations not being good, I arrived shortly before noon. I was to lecture in the evening, and so had the afternoon on my hands. I am rather active, and thought I would go out and see what I could see of the country. I took a long walk, and came back just before supper. On the way back, crossing various by-ways and fields, I came out by a church and then on down through the main street of the town. It was some time in the spring, — possibly that was what attracted my attention, for there was a single peach tree in bloom in a yard, and I noted it was an attractive-looking place. I went on down to the hotel, got my supper and made a few changes in my toilet before starting to the hall. In the midst of them a boy said there was a gentleman down stairs who wanted to see me. I said I couldn't go just then, but would go down as soon as possible. I went down, met the gentleman, whom I didn't recognize, and I hadn't been in his presence two minutes before he began to question me concerning raspberries. Then I looked at him, and said, "Didn't you attend the farmer's institute at so and so?" "Yes," he said, "I guess I did, because I saw you there; I came in to ask you if you didn't want to go up and look at my raspberry patch." I said I should be delighted, and we started. I was telling what I had been doing that afternoon, and he was trying to give me a description of his place, and from his description I suspected it was the place I had passed. He said, "You must have seen our church." I said, "Yes." "Well," he said, "that is a new church; the old one was struck by lightning two years ago, and that is a nice new church." I said I had no doubt it was a modern building. It might have been a modern cow stable, as well as anything else, but I didn't hurt his feelings any more than I could help in talking about the church. He remained silent a moment or two and then he let fall a very shrewd thing. He said, "I would like to hear a man preach that loved to preach as well as I love to raise raspberries." I said, "I guess you are right; no doubt he would be worth hearing." Then we reached the raspberry patch, and it was absolutely the most beautiful sight, horticulturally speaking, that I have ever seen. Not a particle of winter-killing, every cane in its place, and the whole covered a foot deep in leaves; not a weed in sight. And I knew, without his telling me, that he must raise magnificent fruit. He was making a splendid success away up there on that variety, ordinarily considered delicate, because he loved it.

A number of years ago Professor Maynard of Amherst made arrangements to buy all the waste straw braids and mattings that came from the shops. He covered the raspberry patch about a foot deep with these, and they kept out the weeds and grass absolutely for a number of years. I never have seen better raspberries grown, — because I didn't see my New Hampshire friend's patch in fruit.

And just a word about the grape. There is an acre of grapes on the college grounds at Amherst that has a very rare location in regard to slope and elevation. Professor Maynard told me, he having known it for twenty-five or thirty years, that it has not failed to produce a profit, and it has averaged about 3 tons to the acre, and the selling price has averaged 5 cents a pound; and he said the cost of caring for it has certainly been less than the cost of raising and caring for an acre of potatoes.

Would Mr. Hale, in attempting to raise gooseberries, try the English or the American type?

Mr. Hale. The best American type, — the mildew is so serious a feature of the English. I presume there are modern methods of growing the gooseberry. Some of our best American types are good enough, and are sure bearers and more profitable on the whole, although they are not profitable unless you have enough people who appreciate them to create a market.

Question. Can you take care of the cantaloupe with the spraying machine?

Mr. Hale. The blight has been very severe in the last five years. Some of our scientific friends are finding they know less about it than they thought. I mean the more we study, the less we appear to know. The fellow who sprayed has held it quite considerably in check. A scientific man, a chemist, who loves the soil and loves the things that grow out of it, — he only has two or three high-priced chemist jobs a year, and manages to live on them the rest of the year, — thinks he has a plant food mixture which will make the plants resistant to the blight; and two years ago, on Long Island, on the south shore, where the fogs and the conditions are very variable, where he treated his vines with this particular plant food, he succeeded in growing superb melons where others failed. I only grow them for family supply, three or four fields of different varieties, but he begged the privilege of treating them this past summer. Those that we didn't spray went down first entirely by blight, and the ones we did spray were absolutely free from it until they got about two-thirds through the season, when all at once they went all to pieces. I wouldn't try to grow cantaloupes without spraying, and I wouldn't stop trying to grow them simply because I had not succeeded so far.

QUESTION. What about the possibility of growing dwarf pears? Some people favor the dwarf pear tree for commercial purposes.

MR. HALE. I know some of the varieties have succeeded well as dwarfs. I had an orchard of four acres at one time, and did fairly well; but I was in love with peaches, and did better with peaches. I think I would rather have the standard trees. I think I would prune them and keep the tree down very low. I would thin it out, so as to broaden it out.

QUESTION. What strawberry would you recommend for midsummer?

MR. HALE. Stevens's latest, Haverland and Mead-Midseason, or a half dozen other good ones. The Mead, which was rather a shy bearer the first few years, is beginning to be a heavy bearer. Then Glen Mary, Lady Garrison, Sample, Abington and Ryckman.

QUESTION. How often would you spray the cucumber or melon plant?

MR. HALE. Spray first as soon as they get leaves on and begin to run; then as often as you get time, — every week or so.

QUESTION. What varieties of Japanese plums do you recommend?

MR. HALE. The Red June, which is hardy; the Abundance, which is the sweetest; the Burbank, which is good to keep, and a tremendous bearer; if allowed to overbear, is very poor, and is of high quality if thinned out; the Satsuma for canning puts everything else in the shade. Speaking of fruits for local markets, we have found that the Satsuma plum, — it is a dirty, reddish-brown chocolate color on the outside, very unattractive looking; cut it open, and it is red as a beet; its appearance is such that people don't want to buy it, — but, harking back fifteen or twenty years, we sold it for $1 per half-bushel basket; and the ladies who bought it liked it, and told their friends, and the circle kept widening; and we put the price up to $1.25, and the circle grew wider until we put it up to $1.50; there was a shortage one year, and they brought $2. So we are able to get from $1.50 to $2 a half-bushel basket for Satsuma plums, when peaches of a high grade won't bring over $1, and other grades won't bring that.

Evening Session.

An evening session was held at 8 o'clock, at which Mr. Edward Howe Forbush, ornithologist to the Board, delivered a stereopticon lecture on "Useful birds: how to attract and protect them." By request, the lecture is not included in this volume.

SECOND DAY.

The morning session was opened at 10.30 o'clock by Secretary Ellsworth, who introduced Mr. Warren C. Jewett of Worcester as the presiding officer.

The Chair. The subject we have before us this morning is one that is often before the public, as it interests many people outside of agriculture, but it affects the majority of the farmers of Massachusetts more than any one, really, — "The production of sanitary milk." When the State Board of Health wants us to make it at the prices we are able to get for it, it is certainly a serious question to the farmers of Massachusetts. I think we are fortunate to have the speaker we have before us, a man with a large amount of experience and observation. I have the pleasure of introducing to you Mr. F. E. Dawley, State Director of Farmers' Institutes, Fayetteville, N. Y.

THE PRODUCTION OF SANITARY MILK.

F. E. DAWLEY, FAYETTEVILLE, N. Y.

In treating this subject, I shall first say something about the production of cleaner milk for general market purposes, as I believe that the proportion of certified milk, so called, is so small that at the present time we should treat it on the same basis that other luxuries might be treated; and that dairy farmers, as well as boards of health or other officials having the people's milk supply in charge, should bend their energies toward a cleaner market milk, as the demand for certified milk will be met by an adequate supply as soon as the consuming public is willing to pay the necessary cost. It can be laid down as a safe proposition that the people, in most cases, are getting as good milk as they are paying for; and, considering the increased cost of labor, lands and feed, there is not the margin of profit in market milk production to-day that there was a few years ago, while the demand calls for a higher-grade product, at a greater cost for help, and more scrupulous care than ever before.

Since the dawn of history milk and milk products have played a most important part in the dietary of civilized man. When used discriminatingly, no food product is more healthful, satisfying and nutritious. Occasionally those who have not investigated the value of milk as a food restrict its use in the family; and I fear that no one is more guilty of this than the producer who sells market milk, under the mistaken idea that it is an expensive food. Without entering into any argument, analyses prove that 1 quart of milk, containing 5 per cent butter fat, and costing in the market from 5 to 12 cents, is equal in food value to 5/6 of a pound of sirloin steak, costing from 15 to 20 cents; and, as meats are generally cooked, it is probably far more digestible and the comparative value greater than I have indicated.

It is fair also to compare the luxuries of life on the basis of their food value, as well as their palatability. Peaches and cream seem to be naturally associated together. A pint of cream, containing 20 per cent butter fat, is equal in value to 4½ quarts of peaches; and, while strawberries and cream seem to be intimately associated, a pint of 20 per cent cream is equal in food value to 5 quarts of strawberries. I do not mean to advise you to take more cream and less strawberries, but I simply wish to present the thought that the two taken together are not a wonderfully expensive luxury, the cream doing its share in furnishing the food value. If these combinations of fruit and cream could be used more for dessert purposes, replacing pastry to a great extent, the consumer would gain both in economy and health.

There are five conditions which determine the value of milk for human food. Some may differ with me as to the order in which I give these prominence; but I should place first the health and physical condition of the cow; second, the composition of the milk; third, its cleanliness and the cleanliness of the surroundings where produced, which determine the length of time it will remain sweet and palatable; fourth, its flavor, or taste and odor; and fifth, its color and general appearance.

No matter how well all the other requirements be met, if the cow producing the milk is not in good health, you fail. While the medical fraternity has often charged the cow with responsibility which rests on the dairymen's water supply, she has not always been guiltless, and should be examined regularly as to her health, digestion and general condition. Tuberculosis, tumors, skin disease and enlarged joints should send the cow to the infirmary, not alone from the standpoint of milk production, but because of the general danger to the herd.

I presume it will be a long time before we all agree as to the ideal composition of milk for family use. I breed both registered Holsteins and Jerseys, and own a varying number of grades, as I have found by costly experience that it does not pay in the long run to feed costly registered cattle as heavily as I like to feed my producing herds, — not that they do not stand heavy feeding for a time, but the time is too short before injury is manifest. For our home milk supply we have always selected a registered Jersey cow, fed her moderately, known that she was free from tubercular or other trouble, and fed the children on such milk. I glanced back through some records a few days ago, and find that the average tests of these cows kept for the family cow for fifteen years have been 5.2 per cent of butter fat. Too rich for health, says my Holstein breeder friend. Well, such milk has grown three healthy children, all we ever had, and we have paid out less than $10 in doctor's bills for them and their mother in the fifteen years. What is one child's meat is another's poison, and I do not advocate feeding all children milk containing 5.2 per cent of fat. The question of individuality enters into all these matters of digestion and assimilation, and you and I as producers must meet the public demand.

In considering this question of cleanliness, we shall also take up the matter of flavor and odor, as they are so closely associated that it is impossible to consider them separately without much repetition. It is probably true that in many stables the conditions are such that it is difficult to secure anything approximating absolute cleanliness of the stable, but most of us can do better than we are doing. The only practical stable for the production of pure milk is one in which the ceiling is tight and smooth; the side walls are tight and smooth; and the floor of cement, with gutters and drops all tight and smooth as is consistent.

The silos should be far enough from the stable so that when the silage is thrown down it can be kept outside the stable and brought in for feeding. No more should be thrown down at any time than can be used for that one feeding. The hay should be brought into the stable in such a way that as little dust as possible is raised; and, to get the best-flavored milk, the cow should be fed after milking. It has been stated by some that it was impossible to make a clean-flavored milk when feeding silage. The results seem to indicate that, if this food is used carefully and judiciously, silage-made milk is preferred by the greater number of consumers. Some of the experiment stations have made tests of this, and, so far as I have been able to ascertain, the results are all favorable. The Illinois station has perhaps made an experiment which covered more persons than any other one. The dairy herd was divided into two lots, one of which was fed 40 pounds of corn silage per cow, while the other lot was fed clover hay and grain. During the course of the experiments sample lots were submitted to 372 persons for an opinion as to any difference in flavor of the two samples, anything objectionable about either, and any preference. The results showed that 60 per cent preferred the milk from cows fed silage, and 11 per cent had no choice. Samples of each kind of milk were sent to experts in different States, three of whom preferred the silage milk, one the non-silage milk, and one had no choice. Silage milk was delivered to a hotel for the period of one month, and no complaint was made as to the quality. Allowing silage to stand in the stable seems to affect the flavor of the milk far more than feeding it. All excrement from the animals should also be removed from the stable at least twice a day.

Milk should not be allowed to stand in the stable at all after milking. Professor Russell of Wisconsin has made some very interesting experiments in relation to absorption of odors by cold and warm milk. A number of substances having strong odors were placed in contact with the milk, among them being the volatile, essential oils of cinnamon, wintergreen and peppermint, also corn silage, manure from horses and urine from cows. The milk was exposed to these odors in a large box; and the results show that, while milk absorbs odors when either warmer or cooler than the surrounding air, the absorption is much more active when the milk is warm than when it is cold. The odor of peppermint could be detected after a ten-minute exposure. The milk was also readily tainted by the odor of the fresh urine. The data obtained in these experiments show conclusively that no man can produce the finest-quality milk when he allows, as I am sorry to say many do, his pails of milk to stand in the stable for some time after it has been drawn from the cow. They also show the necessity of having the stables absolutely clean and well ventilated, if we are going to produce the best milk. If simple exposure to these odors so readily contaminates the milk, how about the dirt which clings to the cow's body and which may drop into the pail? It is not necessary for me to give in detail the results of experiments in regard to this. Every producer knows from experience the necessity of keeping the milk clean, but few of us are as careful as we should be.

Where men are getting the best results in making clean milk, they have found it best to clip the long hairs from the udder and flank of the cows; to groom them thoroughly; to use some material for bedding which does not carry a large amount of dust, and, if it is dusty, to moisten it slightly to keep the dust down.

While I consider the bacterial count to be far from an ideal method of estimating the value of the best quality of milk, from the fact that it does not distinguish between lactic acid and other bacteria, — even the pathological ones, which are those which cause disease, — it is probably the best system which we have at present upon which to base our judgment; and it has been proven conclusively that very small particles of dirt falling from the cow's body increase the count enormously. Very few of us realize how rapidly bacteria increase in the milk, and how easy it is to introduce a remarkably vigorous parent stock. For instance, at Cornell University 500 c. c. of sterile milk were kept at room temperature, and a live fly was placed in this milk. At the end of twenty-four hours the milk contained 765,000 bacteria per c. c., and in thirty-six hours the number had increased to 5,675,000 per c. c. A piece of hay about an inch long was placed in sterile milk. In one hour it contained 3,025 bacteria per c. c., and in twenty-four hours over 3,000,000. One piece of sawdust from the stable floor was placed in the milk. In twenty-four hours it contained 7,000,000 bacteria per c. c. One hair was pulled from the cow's flank and placed in 500 c. c. of sterile milk. In twenty-four hours it contained 55,000 bacteria per c. c., and in thirty-six hours over 5,000,000 bacteria per c. c.

Haecker and Melick have also reported observations on the contamination of milk during milking. Petri dishes were exposed under udders which had been (1) sponged with water, (2) sponged with a 5 per cent solution of carbolic acid, (3) smeared with vaseline and (4) merely brushed with the hand. The ordinary motions of milking were gone through with, but no milk was drawn. When the plates were exposed in the pasture the number of colonies which developed from exposure under udders treated with carbolic-acid solution was 65, with vaseline 92, with water 120 and untreated 310. When the exposures were made in the stable, the corresponding numbers were 344, 346, 483 and 20,500. These figures show the value of sponging the udder as a means of reducing bacterial contamination, and also the greater danger of contamination when the milking is done in the stable.

Professor Fraser of the Illinois station has made some very interesting experiments, and draws the following conclusion: —

> Paying special attention to cleanliness in every step of the production and care of milk will result not only in clean milk, but in a marked reduction in the number of bacteria it contains, which will greatly lengthen its keeping qualities. That the desired results may be obtained, care must be constantly exercised. It is of little consequence to practice extreme cleanliness in all of the steps of milk production but one, and be filthy about that one, as this spoils the whole. Even if the majority of species of bacteria which ordinarily gain access to milk are not dangerous to health, no one cares to consume milk in which a sediment is found at the bottom if it is allowed to stand for a short time. Frequently much filth is allowed to get into milk during milking, and many milkers practice the filthy habit of keeping the teats wet with milk during the milking process; yet after it is drawn the greatest care is exercised that no dust or dirt gain access to it. As far as the final result is concerned, all painstaking care in the subsequent operations is lost because of the careless work at the beginning during the process of milking; for if filth once gains access to milk, no amount of care afterwards can remedy the difficulty. It is therefore of the greatest importance to the advancement of better dairying that special emphasis be placed upon the opera-

tion where milk is liable to receive the most contamination. The results show that the greatest source of contamination in milk, as ordinarily produced, is the cow herself; and this is doubly important, because it is the source which is given the least attention in actual practice.

The advantages of using covered pails with small openings are apparent, from the fact that we have shown that one of the most prolific sources of contamination is from the cow and stable at the time of milking. When these small-topped pails were first introduced into my own stables, the men claimed that they could not milk into them; but when one of them was reminded that one of his diversions was milking into the mouth of a cat, sitting up on her hind legs, his objection was readily overcome. One of the most interesting experiments with small-top or covered pails was made at the Connecticut station by Conn and Stocking. The milk of one cow was drawn into an ordinary open pail one day, and no extra precautions taken to exclude dirt or bacteria. On the alternate day the cow's tail was tied to her leg, the side, flank and udder washed with 3 per cent solution of boric acid and wiped with a sterilized cloth. The milker washed his hands with boric acid solution, and wiped them with a sterilized cloth. When two teats had been milked, the washing of both the cow and the hands of the milker was repeated, and the remainder of the milk was drawn through four layers of sterilized cheese cloth and a layer of absorbent cotton into a sterilized covered pail. In two series of experiments the milk obtained under the extra precautions to prevent contamination contained 267 and 242 bacteria per c. c., as compared with averages of 3,888 and 3,116 respectively when no extra precautions were taken. When the two kinds of milk were kept at 70° F., the milk obtained in the ordinary manner curdled on an average in seventy-nine hours, while the cleaner milk did not curdle until the end of one hundred and thirteen hours. At this same temperature the average increase of bacteria in thirty-six hours was thirty-fold in ordinary milk, and tenfold in milk where aseptic precautions had been taken.

All utensils used in milking or in handling the milk should be thoroughly sterilized. It is not enough that the pails and cans be washed, — they should be thoroughly scalded with steam or boiling water. In all dairy operations sal soda should be used instead of soaps.

The ideal flavor of milk might perhaps be regarded as a negative rather than a positive flavor. It should be slightly saline and sweet, with no after-taste whatever. The color of milk plays a more important part in getting a good price for a good product than some are willing to admit, and is affected by the individuality of the cow and the feeding. By selecting for each herd some cows that give a high-colored milk, and discarding those which impart too much "sky-blue;" by judiciously feeding with succulent foods and alfalfa and clover hay, and if necessary some roots, — one can influence the color to a marked degree.

In sections remote from our large cities, where milk is shipped in by rail, the farm conditions are far from ideal. It is unfortunate that the buildings on many of these farms were not built for dairy purposes, but were built when more general farming was carried on, and have been only slightly reconstructed to enable cows to be kept in them. It is true that here the sins are more largely of omission than of commission; and one of the reasons why the existing conditions maintain is that milk made under these circumstances is taken to the shipping station, and brings the same price as that made on the best-equipped farm in the vicinity. The only way to remedy this evil will come from complete inspection by a corps of men who are qualified not only to inspect, but to instruct, and who can give suggestions for improving the conditions without the expenditure of too large sums. This thought brings us again to one already expressed, — that with the demand for a better milk on the part of the consumer must come a willingness to pay a better price, and the dealers and transportation companies must recognize the rights of the producer, and see that he gets a just share of what the consumer pays.

This inspection should not only cover the premises where the milk is made and the cattle kept, but the physical condition of the animals; the health and general cleanliness of the milkers; the condition of the utensils, with power to condemn those from which the tin had rusted or worn off; the methods of handling and storing the milk after it is drawn; and the feed of the animals. The class of men selected for this work should be such that they can be given almost absolute authority. From a careful study of the clean-milk problem, I am thoroughly convinced that no system of inspection of the milk itself will ever bring about the conditions which we desire, but that a complete and thorough inspection on the premises where the milk is produced is the ideal toward which we should work. Some will object to the expense of this; but if the danger in consuming is only half as great as our physicians believe and as carefully prepared statistics seem to indicate, much more expense than this inspection would entail is justified.

Some have thought that pasteurization was going to solve all the difficulties regarding our milk supply; but pasteurization, unless more thorough and complete than is usually given in a commercial way, kills only the lactic acid germs which nature placed in the milk as a protection, while the pathological germs, which are really the menace to health, are left in an alkaline instead of an acid medium, all ready to multiply when other conditions are favorable. The danger of using pasteurized milk may be far greater than using it when unpasteurized. The fact that this idea of pasteurization has been exploited so greatly at our dairy and other conventions has led many farmers to believe that it was a cure for all evils, and that there was no necessity of their taking better care of their milk at home, since running it through the pasteurizer would eradicate the results of all the sins that they committed.

In our large manufacturing establishments methods and appliances are often changed almost completely, at great expense, to reduce the cost of production or to improve the product. In clean-milk production we have two prime factors that by careful study we may reduce: one is the cost of production, and the other is the bacteriological count. In a stable recently visited, taking down the silos and erecting them in a more convenient place decreased the labor cost of the milk about $\frac{1}{16}$ of a cent per quart; a like change in the location of the grain bins and installing a car for carrying the feed reduced it $\frac{1}{8}$ of a cent more. It does not amount to much? Only $1.50 a day, or $270 for the winter. In many stables installing a practical litter carrier will reduce both the cost of production and the bacterial count.

The poor cow seems to be continually with us. Get rid of her, and reduce the cost of production. What is a good cow worth? Figure it out for yourself to-night. In New York State twelve years ago the average milk production was only 3,000 pounds, and the average butter production 127 pounds. In our institutes and other institutions of agricultural instruction we began a systematic campaign of education in "cowology." In season and out of season we urged the necessity of better cows, better feed, better breeds and better care. Every one in the work got the habit. At one meeting a good old Scotch minister was opening the meeting with prayer, and in the course of his remarks fervently asked that those farmers in the locality who had not yet been touched by the spirit of progression, and who were still feeding their cows as Noah fed his, be impressed with the necessity of education along these lines, and that their hearts be moved to bring them out to hear the lectures. Every one was interested. Cows were brought into the meetings, and used instead of charts, to impress people more particularly. Ten years later the returns show that, owing largely to this campaign, our average cow in New York was giving 4,600 pounds of milk, and could make 185 pounds of butter. If the average cow of twelve years ago was worth $35, and she gave 3,000 pounds of milk, how much was the average cow of two years ago worth, who was giving 4,600 pounds of milk, and how much is the best cow in your barn worth? Figure it out, and write me a letter. This is probably the most fertile field to work in reducing the cost. Weighing the milk from each cow regularly, week in and week out, and keeping an accurate record, is the basis on which to work.

Many of us can save large sums by being more careful in our feeding. In many a stable more pounds of feed are given an individual cow than she can pay for. The food limit should be governed by the ability of the cow to give a profit on what she is eating. On farms where the conditions are such that the soiling system can be adopted successfully, it is probable that the cost of milk can be reduced to a marked degree; but the number of such farms is limited.

In some oriental cities the consumer of dairy products has become so convinced that fraud is practiced in handling them that he demands that the cow be driven from door to door, and milked in his presence. If he had studied the subject of milk production as thoroughly as we have, he would know that those who get the first milk from the cow were getting practically skimmed milk, while the one who got the last pint was getting nearly cream. The last man, however, should be getting milk that was practically free from bacteria; and perhaps, when we consider the stories that are told in relation to the handling of milk and milk products in some of those countries, the consumer may not be so unsophisticated, after all. It is reported in "Milch Zeitung" that Professor Schlossman, in a lecture before the milk dealers of Magdeburg, spoke about the danger of milk absorbing odors and taste from other matter kept near the milk, and in some experiments submitted samples of absolutely pure milk to parties who claimed that it lacked the "true milk taste." Then he gave them a sample to which a grain of cow dung had been added, and it was declared to have the "true milk taste."

While it is true that much clean milk goes to market in cans, the bottle, filled at the farm and securely capped, is the most cleanly and satisfactory way to handle it. The equipment is quite expensive, but the milk which is lost in dipping, together with that which is slopped, will, it is claimed by many producers, pay the cost of the bottles. It should be remembered, however, that, unless it is properly cared for, the glass bottle may be the most unsanitary method of delivery. Some bottles will come from families where the cleanliness is questionable, or where there is disease, and it seems to have been proved that disease germs can be carried in them.

The absolute necessity of thoroughly cleansing and sterilizing the cans or bottles, no matter which are used, is obvious; and the fact that milk dipped from an open can on a public thoroughfare in a windy day is bound to be greatly contaminated by street filth should lead every municipality to demand that all milk be delivered in sealed packages. How long could a man deliver consommé or mock-turtle soup from an open can to the residents of this city? How many of you would relish succotash that was brought to your door in forty-quart lots, and a pint or quart dipped from the top of this can into an uncovered pail, and hung on a hook on a tree until you were ready to go out after it? No other food is handled in such a slovenly manner as dipped milk; and if the consumers will not protect themselves, they should be protected by municipal enactment.

The methods of milk delivery are still primitive and vexatious, the producer is obliged to travel too far to deliver his product, and it is not in as good condition when the consumer receives it as it should be. In a city not many miles from here I am told that on one city block about a week ago seventeen different milk wagons traversed the block and made deliveries.

I find that I have taken up more time than I intended on this phase of the subject. While all milk should be clean milk, it is a fact that it is not; and out of this fact there has grown up during the past few years a trade in so-called "sanitary" or "certified" milk, and I wish to tell you something about what we are doing in making that in New York State.

As soon as the demand for this milk was manifest, unscrupulous dealers began to call anything "certified;" and, while the time for an arbitrary standard had not yet arrived (if it ever does), it was thought best to enact a law making it a misdemeanor to use the word "certified" unless the milk was made under the inspection of some qualified body. Hence, certified milk in New York State stands for something; namely, a pure, rich, unadulterated milk, produced in accordance with rules and regulations laid down by some recognized medical society or board, and endorsed (certified) by them. This allows the word "certified" to be placed on the bottle cap and on the delivery wagons. If any persons are selling milk as certified in New York State made otherwise than in accordance with such regulations, he is violating the law.

There are probably some forty farmers in New York that are making more or less milk under these conditions. The majority of these are some distance from their market, and the milk is sold through dealers. It is probable that the most perplexing problem for the individual producer is this matter of delivery. In one of our inland cities, where a very fine quality of certified milk is sold for 10 cents a quart, I am informed that the cost of delivery is as great as the cost of production ; and my own experiments at home lead me to believe that one cannot produce certified milk, running with approximately 5,000 bacteria per c. c., at less than 7 cents per quart and stand bottle losses. I am also told that one of the firms delivering a certain brand of certified milk in New York City travels something over 100 miles in delivering the output of this farm. Of course they deliver many quarts of their regular product at the same time. Except in the smaller cities, the large milk companies must be depended upon to make the sales. It is stated that in New York City and Brooklyn something over 12,000 quarts of certified milk are sold daily. The Mercantile Exchange of New York states that, in 1905, 1,992,267 quarts of market milk were sold daily ; so you can see that, while there is a growing demand for the certified product, the amount sold is comparatively small. The demand is bound to increase, however ; and to-day farmers who are so situated that they can make a good product will have no trouble in finding a market for it, if the quality is right. In working up a business in certified milk, in a city where it is not sold, it should be remembered that a short promise filled to the dot is worth more than a volume of assertions that are carelessly made. Secure the co-operation of the medical fraternity, and be conservative. Do not say your products are the best in the world unless you are sure of it. Some bacteriologist may disprove your assertion, and you will find it necessary to substantiate your argument with a nearly perfect milk.

Perhaps the most successful producer of sanitary milk in New York is Mr. S. L. Stewart. He was one of the pioneers in this line of work, and his success in producing a milk which is now selling for 20 cents a quart in New York City has come largely from constantly striving to do better things in better ways. He has torn down and rebuilt portions of his stable, which seemed almost perfect, in his constant effort to reduce the bacterial count. While he has adopted methods which are almost equal to hospital conditions, and which to the uninitiated may not seem profitable or necessary, he tells me that in every instance where he has reduced his vigilance and allowed any one of these operations to be slighted, the bacterial content of the milk has increased. It is true that there are others who are making certified milk whose methods are not so thorough. However, I would advise any person who thinks of entering into certified milk production to adhere as closely as possible to Mr. Stewart's ideal. His cows are kept practically under hospital conditions, his stable kept as nearly antiseptic as possible, and the product warrants the care.

In relation to the requirements, Mr. Stewart says: —

> In order to produce clean milk, free from pathological germs, certain vital requirements must be complied with, namely: —
>
> An abundance of water, free from any possible contamination, must be assured.
>
> The buildings should be located where good drainage can be had, which means a good drainage away from the buildings.
>
> A milking barn, which would better meet all requirements if but one story, with no room for storage above; the floors of which should be of cement, with side walls and ceiling either of concrete or plastered on wire lath; all corners rounded, leaving no place for dust or dirt to collect. All frame work for stanchions should be of galvanized iron, with steel stanchions. The drainage and plumbing of this building should be as sanitary as the best living room, for here must be kept the cows from which the milk is made, and the air must be kept from any contamination from sewage.
>
> Proper ventilation is another very vital point in the milking room, and too much care cannot be exercised in the installation of the same. The "King system" of ventilation, when prop-

erly installed, has made it possible to so change the air in a building filled with cows that no odor is apparent. This system consists in introducing the fresh air from the outside in ducts extending from just above the ground to near the ceiling line on the inside, such ducts being distributed around all of the four sides of the barn. No bank or basement barn is adapted for such purpose. Dividing the total square inches of inlet needed into as many ducts as can be conveniently installed makes the volume of cold air more evenly distributed and more easily warmed. The requirements regarding size of inlets and outlets can be regulated by allowing 30 square inches for each 1,000 pounds of animals to be housed. The outlets are to carry off the carbon dioxide gas which is thrown off from the lungs of the animals, and which, being heavier than the air, falls to the floor. Hence the outlet opens near the floor, extending to the ceiling, then to the peak of the roof, then taking the form of a chimney, through which the foul air is emitted. This chimney should be high enough to be above any surrounding obstructions that would affect the draft. The windows should be continuous, except for the space taken by the ventilating flues, posts, etc. Have as near as possible 10 feet square of glass for each cow, as sunlight is the cheapest disinfectant that we have. To prevent the building from becoming too cold during the night, double sash must be used from fall until spring.

The "milk-receiving room" connected with the barn should be a room into which each pail of milk is taken to be weighed and strained. This room should be connected with the barn by a passageway having a double swinging door at each end of the passage, one closing behind the milker when he leaves the barn, before the other door opens into the receiving room, thereby excluding any barn air from the room. In this room should be a wash bowl, with hot water, towel, etc., so that the milkers can wash their hands after milking each cow. The dairy building should contain a wash room, where all bottles, cans, pails, milking stools, etc., are washed, by first thoroughly rinsing them in warm water, then washing them with a brush, using washing compound and hot water, after which they must be thoroughly rinsed in clean water. A bottling room adjoins, connected only through a pressure sterilizer, through which all utensils and bottles used must pass after being washed and rinsed, and subjected to 10 pounds steam pressure, or 240° F., entering the sterilizer in the wash room and passing through it into the bottling room. Near the bottling room should be located a cold-storage room, in which the milk can be stored after leaving the bottling room, from which it can be shipped as desired. A boiler room, men's wash room and laundry are also necessary, and should be situated adjacent to, but having no connection with, the other rooms.

After the barns are perfectly clean, by being washed down with hot water and scrubbed with brushes, using a washing compound on the floors, mangers and walls, the cows should be groomed, their bodies thoroughly wiped with wet towels, tails and udders washed, and their udders dried with clean towels. The cows being properly cleaned, the milkers (who should be above suspicion in regard not only to their own health, but to the health of those with whom they come in contact, as disease germs are easily carried, and milk is an excellent medium by which they can be conveyed to the consumer) should proceed to the men's wash room, washing face, hands and hair, don white laundered suits and caps, procure a milking pail and stool, which utensils have been sterilized, then proceed to the milking barn properly equipped for milking. The first stream must be discarded, as it may harbor some bacteria contained in the end of the teat.

After milking the cow, the pail is taken into the receiving room, the milk weighed and strained through a cheese cloth strainer. This strainer should be changed for each pail of milk, as it is used only as a precaution in case a hair or some other foreign substance gain access to the pail. If the same strainer were used continuously, it would tend still further to dissolve and force the contamination through the strainer, and so contaminate the milk from the pails following, which may have been free from such contamination. Do not attempt to strain anything out of milk; rather do not let it get in. It has been found, by repeated bacteriological tests, that the results were just the same from samples taken direct from the pail as when strained through sterilized cheese-cloth strainers, and that their use in a dairy where surgical cleanliness is applied is more a precautionary measure than otherwise. By no means should a metal strainer be used.

Before returning to another cow, the milker must carefully wash and dry his hands. As soon as each can is filled it should be immediately conveyed to the bottling room of the dairy, where it is cooled to 38° or 40° F., bottled, capped and put into a cold-storage room. This should be done within ten or fifteen minutes of the time of milking. The milk should be held at this temperature until ready for delivery. Too much care cannot be exercised to cool the milk quickly and keep it cold, as cleanliness and cold are the two main factors in the production of milk that will keep sweet for any reasonable time. Add to this a healthy herd of cows and healthy attendants, and we have a summary of the necessary requisites for the production and care of clean milk.

Another of the New York farms making a fine certified milk product is that of Hon. C. A. Wieting, our State Commissioner of Agriculture. Here practically the same careful attention is given to production as is given at Mr. Stewart's farm. To show you how small a matter may cause trouble: as one of the State Fair Commissioners, Mr. Wieting was necessarily away from home during State fair week last fall. The people who were caring for his farm at Cobleskill had been in the habit of hanging the strainer cloths on a clothes line in the sun. The particular spot where they hung had been protected from the street during the summer by a heavy growth of corn. During the week of the fair the corn was cut for silage purposes, and the wind swept down the street and across the corn land to where the strainer cloths hung. When Mr. Wieting returned home the next week, the reports showed that the bacterial count of his milk had gone up to 36,000, and he began a careful investigation. Everything about the stable was carefully gone over. The utensils were all examined carefully. Questions were asked as to the icing and other conditions which had existed during the week, and slight alterations were made where they seemed warranted, but the next week the count went up again. Mr. Wieting put in a day at the farm, examining everything, and finally found these cloths on the line. Not because he felt that this was the probable source of contamination, only a possible one, he told the men to put them into a Lisk roaster, which happened to be on the premises, and bake them thoroughly, carrying them to the milk room in the roaster without opening. This was done. The bacterial count dropped that day to less than 3,000.

On another farm, during silo filling, through some slight accident a pane of 7 by 9 glass was broken from a window in the milk room, allowing relatively small quantities of dust to enter that room, and the count went up 40,000 per c. c. Replacing this glass and whitewashing the room brought the count back again to the usual number. I might spend the rest of the day in citing instances where just such trifling things as these had played havoc with the production of certified milk; but these two instances will show the necessity of adhering closely to the rules.

From having inspected the plants at Gedney Farms, Briarcliff Manor, Mr. Stewart's, Mr. Morgan's and others, many people have gotten the idea that the equipment necessary in making sanitary milk is very costly. While it is perhaps easier to make the best quality of milk where the buildings are new and the ceiling and side walls made so tight and smooth that no dust can accumulate upon them, there are many successful farms where no great amount of money has been expended. I scarcely think the extra cost of making our barn thoroughly sanitary was more than $500[1] above what it would have been to have constructed it on the ordinary principle. In the extensive plant of Commissioner Wieting, at Cobleskill, the conditions are similar to those on the very best ordinary dairy farms, the milk being made sanitary by most careful watching and scrupulous care.

On the farm of Mr. J. S. Shattuck, who is one of the most enthusiastic certified-milk producers in New York State, not to exceed $1,000 was spent in rearranging the old stables, preparing the milk room, bottling establishment, etc. Last year, from 40 cows, Mr. Shattuck sold 84,321 quarts of certified milk for $4,215.98; he also sold 513,639 pounds of milk, and received $818.80, the price for this ranging from 90 cents to $1.85 per 100 pounds. Two families on the farm that year used 1,825 quarts. The milk on this farm shows an average test of about 4.5 per cent of butter fat.

On the Winters's farm, at Smithboro, certified milk is made for the Brooklyn market. Here the appliances are thoroughly up to date, and the most scrupulous care is exercised.

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[1] These figures, of course, do not include the milk room.

At present the milk is being sold at 6 cents per quart. Mr. Winters tells me that, at the present high prices of grain and labor, he would not attempt to make milk for any less; and, as there has been a recent raise in the price of certified milk in the city markets, he is hoping to get something more out of the product.

It would possibly be of interest to you if I should give you some facts in relation to some of the other certified farms in our State, but time forbids. I already feel as though I had trespassed too much on your time.

It is not on every farm that certified milk can be made. It is not every man who can expect to achieve success, if he goes into the business. Only those who are naturally the most careful and painstaking can hope to achieve success, and few dairymen can enter into the making of certified milk and make a profit above that received from their present system. You know it does not always pay to break away from old methods in our attempts to be original. The hen who concluded that she had discovered a better way of laying eggs than the antiquated one of laying them in a nest, tried laying from the perch, and she made a mess of it. However, we must all bear in mind that yesterday's methods in milk production will not bring success in to-day's work. The public is demanding a better product; they are entitled to it, and they must and will have it: but it is going to cost more, and they must meet the producers half way and be willing to pay the cost.

The CHAIR. The meeting is now open for discussion. I am sure, from knowledge of Mr. Dawley for a great many years, that he is perfectly capable of answering any question, and certainly is willing to try to answer any you may ask. I hope every minute will be occupied, and that we may have a good discussion.

QUESTION. What bedding would you use under your cows?

Mr. DAWLEY. I believe those who have experimented carefully have found that shavings or sawdust make the most satisfactory bedding, where certified milk is being made.

They are more free from dust than straw or stalks, or anything of that kind. Some men moisten the bedding. I don't believe damp bedding is good for the cows to lie on, and those men may be sorry by and by; but, with a constant endeavor to hold down the count, they do it. In connection with this, I will say that at Mr. Wieting's farm two years ago they used two-year-old straw from the bottom of the mow, and they had to discontinue it, because the count went up so high.

Mr. L. W. West (of Hadley). What damage do these bacteria do to the human body? I have been drinking them for fifty years or more, and I can't see that I have suffered from them so far, — perhaps because I drink only skim milk; I can't afford any other kind. I would like to know what that skim milk is worth.

Mr. Dawley. Unfortunately, all the experiment stations, in determining the value of skim milk, have directed the work along the line of feeding calves and swine. I don't know much about your laws, but I do believe, from the fact that we do not allow skim milk to be sold in New York State, many people are deprived of a first-class food. I believe there are many people who will get almost as much nutrition out of good, fresh skim milk as those same persons would get out of the whole milk. There is a good food value in the fat in the milk, but it isn't everybody who can assimilate that fat. I believe skim milk is a good food, not only for beast, but for man.

In relation to the bacteria, we haven't attempted to enter into any discussion as to what has been done by the various medical societies in reducing the death rate of the children in the cities simply from getting a better milk supply, and I am not sure that I could give you the exact figures from memory. In New York City, children fed from the milk sent out from the Strauss laboratory, practically certified milk, no pathological germs to be found in it, show a marked improvement. In those families where it was used, the death rate of children under two years of age, for one summer, showed 56 per cent less than where fed on market milk purchased from the stores and delivered from the wagons. In every city where certified milk made under the direction of some society, as was indicated in the latter part of my address, is used, the physicians are of one accord in saying that the mortality of infants has been reduced at least from one-third to one-half. Dr. Roby has shown clearly that the death rate from cholera infantum in Rochester in the last eight years has been reduced more than 50 per cent. And we can follow right along, wherever anything has been done, and show clearly in many instances that the death rate in children has been reduced by giving cleaner, better milk. The milk should be watched, as delivered and as kept; and right there is where a whole lot of the danger comes, — in the way it is kept after delivery to the family. Of course a great portion of the germs found in milk are the germs which produce lactic acid; they are in milk naturally. People talk about sterile milk. There have been some germs in every sample of milk that I myself have ever drawn from the cow. Those are natural; it is right they should be there; and if the milk was consumed while fresh, I don't believe any damage would be done. If pathological germs existed, however, damage could without any doubt be done by using the milk. The number of germs often indicates almost wholly the keeping quality of the milk. Milk containing a large number of germs per c. c. is almost always a milk that keeps but a short time without changing; that which contains a small number keeps for a longer time. Ordinarily, for a healthy grown person I doubt if any germs are found in milk, other than pathological germs, which will injure that person; but in feeding children, infants or invalids it does work havoc with them, and brings about cholera infantum in many instances.

Prof. F. S. Cooley (of Amherst). Perhaps I can say a word in answer to Mr. West's question concerning the value of skim milk. It is generally held that the intrinsic value is about one-half of whole milk, the commercial value somewhat less, according to the market. I want Mr. Dawley to say a word about aeration.

Mr. Dawley. It has always been our practice to aerate, using a Star cooler, from the fact that we had running water and could cool it very quickly in running it over that. We found last summer, when we were attempting to conduct experiments in the cost of making milk under certain conditions, that after twenty-four hours the milk contained less bacteria per c. c. when we took samples from the pails warm than from the receptacle cool. We put that aerator in a glass case, where the air was not in circulation and where there was no opportunity for dust to get in, and we found we had just about the same per cent of bacteria in the milk after it was aerated as before; they were practically the same. I thoroughly believe that you will get good results if milk be cooled down in bulk very quickly in fifteen or twenty minutes from the time that it was drawn from the cow.

Professor Cooley. That is not aeration, then, — it is merely cooling; it is aeration without air.

Mr. Dawley. It is cooling, — simply thorough and quick cooling.

Professor Cooley. You spoke of the dipping of milk from cans, as retailed in New York. The Massachusetts custom is to pour into cans of a smaller size; but I know, in this city at least and a few in some other places, of retailers making a difference of 1 cent a quart between the milk in glass and that which is retailed in bulk, holding that it costs them about that much more to handle it in glass than it would in bulk. In my own experience I find that it costs somewhere between $\frac{1}{10}$ and $\frac{1}{20}$ of a cent a quart to put milk into glass and handle it that way; that is, that covers the cost of breakage, and things of that kind. To offset that, there is quite a bill for spilling and over-measure in the retailing in bulk; that I think will fully equal the $\frac{1}{10}$ or $\frac{1}{20}$, if milk is 6 or 7 cents a quart. Personally, I should prefer to have all milk in glass. There are other packages that are coming into use that will be non-returnable, which may be still better in some ways, although in other ways not.

Mr. Dawley. I think Professor Cooley is very fortunate in handling his milk and putting it up in glass so economically, and I think you might take his figures as the minimum, rather than the average cost. It simply shows that he has taken great pains to perfect his methods.

QUESTION. He has a market, too?

Mr. DAWLEY. Yes; but the item of breakage is the one thing that makes it expensive. I hoped to have here some samples of the non-returnable milk bottle, but the manufacturer seems to be having considerable trouble in getting them perfected. Of course your system of pouring is better than the system of dipping that prevails in New York State; but that exposes the milk too much to outside contamination in windy weather.

Professor COOLEY. One other question. Massachusetts seems to have quite a variety of opinions as to what should be the milk standard, and the unprejudiced opinion of an outsider would be worth something to us.

Mr. DAWLEY. I am very frank to say I believe your standard is too high in Massachusetts. Our legal standard is 1 per cent less than yours, — practically, it is only .7 of 1 per cent less than yours; and I will tell you why. That is one of the reasons why your standard is bad. The facts are that in both States we have a legal, man-made standard for milk, and nature doesn't produce that sort of milk. You can find it, as you can find variation in anything; but I will defy you to find a sample of milk in the State of Massachusetts that will analyze in accordance with your legal, man-made standard. The Lord didn't make cows that make that kind of milk; and when a man goes to work and makes a law, whatever it is, that is at variance with the natural conditions, the natural law, just at that moment he is going to have trouble in enforcing that law. Our standard in New York is a 12 per cent standard, 3 per cent of which shall be fat and 9 per cent solids. The result of our examinations in New York State indicate that, if milk as made there contains 9 per cent of solids, it will contain 3.275 per cent of fat, giving us a standard of total solids, don't you see, of 12.275, or practically 12.3. The difficulty is, that the law as laid down doesn't conform with the milk as the cow makes it. You have the same difficulty to contend with over here. Now, I believe this: it is necessary, in order to protect the consumer and the producer as well in these days, when so much milk is being shipped in large quantities through the shipping stations, that we have a legal standard, but I do believe that the legal standard should conform to natural conditions.

Mr. NOAH SAGENDORPH (of Spencer). I have entertained the idea for a long time that there was no farm in the State of New York that sold purer milk than the Briarcliff farm. A few weeks ago I was in the city of New York, and sitting at a restaurant table and looking at the bill of fare, I saw that the milk from the Briarcliff farm sold for 15 cents a glass, and from other places for 10 cents a glass. Now, I visit that farm once a year, or mean to, and I visit a great many of the farms along the Hudson River, and I don't know of any farm anywhere around the city of New York that I would place beyond the Briarcliff farm; and you haven't said one word about it. The last time I was there they were milking 500 cows, and they were trying to bring the number up to 1,000.

Mr. DAWLEY. I will tell you exactly why I didn't mention it by name. The equipment there was made for a purpose other than the production of sanitary milk. The idea of running a dairy farm and making butter and cream and other dairy products was of later date. In a letter received less than two weeks ago from Mr. Law, Jr., he states they are about to tear down the buildings they now have and erect buildings made in accordance with the requisites necessary for the economical production of certified milk, so called, and he preferred nothing to be said until the new equipment came out.

Mr. SAGENDORPH. Hasn't the Briarcliff farm a chemist, a physician they employ all the year round?

Mr. DAWLEY. Yes, sir; and a veterinarian.

Mr. SAGENDORPH. And those cows are all examined once in three months?

Mr. DAWLEY. Yes.

Mr. SAGENDORPH. And isn't there a paper that follows that milk, wherever it is sold, that tells all about it?

Mr. DAWLEY. Surely.

Mr. SAGENDORPH. Can he do anything more than that?

Mr. DAWLEY. Yes, a man can do much more; but we don't ask for anything more than that, — it is enough.

Mr. Sagendorph. If their milk sells for 15 cents a glass, that ought to be enough.

Mr. Dawley. The price it generally brings is 15 cents; of course the restaurants get a little more selling it by the glass.

Mr. Sagendorph. And butter 60 cents a pound?

Mr. Dawley. I presume your figures are correct. Briarcliff is one of the best-conducted farms owned by a wealthy man in the United States to-day, and I presume, too, comes about as close to paying as any one of the farms of this type. Mr. Law has handled it in such a way and advertised it in such shape that I presume he is getting a profit.

Mr. Sagendorph. He says he doesn't care whether it pays or not; he is trying to do something for humanity.

Mr. Dawley. Unfortunately, most of us are situated so we cannot allow our philanthropic motives to run away with us; but I have been talking, not to encourage wealthy men to go into farming, but to encourage the man who is producing milk to make a living from, to make a better milk, a cleaner milk; and if I can induce any man to go into the production of a sanitary milk so he can produce it and make money on it, I think my mission is filled.

Mr. Sagendorph. Wasn't Mr. Law's idea to make the most sanitary milk that can be made?

Mr. Dawley. Yes; but I think Mr. Stewart will run as low in count, day in and out, and he hasn't spent nearly so much money as Mr. Law has; he hasn't it to spend.

Mr. Sagendorph. No; I notice an improvement in Mr. Law's farm every time I go there. He doesn't seem to care whether it pays or not; that is the point.

Mr. Dawley. Yes, that is the point. Since we have spoken of that sort of farm, Mr. J. P. Morgan has the finest appointed cattle barn that I ever visited. Every known appliance has been put in to make it a perfect plant. I will guarantee the milk there has cost him so much that it would have to be sold at champagne prices to show a profit. Of course those things are nice, I believe in them; and I have even gone to the expense of taking men working in our New York State institutes over to Mr. Law's, also to Gedney farm, in order that they may be familiar with what is going on there; and I want to tell you, gentlemen, that all over the State of New York, and this State of Massachusetts, too, I believe, there are many samples of up-to-date farming that are being carried on by wealthy men which are examples for you and me to profit by, but they are not monuments set up for us to try to emulate or copy.

Question. Haven't you more Holsteins in New York than anything else?

Mr. Dawley. No, we have more grade cows than anything else, unfortunately.

Question. Don't they mostly come from Holsteins?

Mr. Dawley. I would hardly want to say that.

Question. And wouldn't a certain amount of that cross bring down the standard of milk?

Mr. Dawley. You carry the idea that I am a Holstein breeder, but I have been a Jersey breeder for twenty-five years. Yet the man who goes into the general milk market to-day with the milk from a herd of Jersey cows, — I don't care if he goes through the country and picks the best, — if he goes into the general market and sells the milk at the price at which milk is sold in the market, he will lose money. I believe the Jersey is the most economical butter cow, and her milk should never be brought in competition in price with that of a Holstein; but the point is right here, you and I as farmers are up against a proposition, — what are we going to do to live? If, with our equipment, — and it is worth just as much to us, as far as it goes, as is his plant to the manufacturer on this river, — we can't give our children the same advantages and education that he can, with a like investment, we would better get out of the business. If our Jersey cow cannot make milk at the price at which you can afford to sell it, get a Holstein. You and I have not yet got quite to the state that the manufacturers came to years and years ago, — give the people what they want and what they are willing to pay for, and don't give them any more, or, if you do, give them a chromo.

Mr. Sagendorph. I once asked Mr. Ellis how it was that he could sell milk at 8 cents a quart, when in my town they were selling it for 5. "That is very easy to answer," he said; "I won't sell it for anything less. I never knew a man yet to pay more for an article than the man who has it to sell asks for it. The only way to sell milk is to say, 'I want so much for my milk,' but if you will sell it for 5 and 4, people will buy it at that price."

Mr. Dawley. That is easy, where you have a market; but when you step up to a shipping station built by the railroad company, and not by the man operating it, and offer that proposition, he will say, "All right; the railroad will build me a station further up the line;" and they are going farther up the line all through New York, and I believe in the New England States. There are certain market conditions that you and I must meet, and you can't dodge them, no matter where you are located. If a man has a community in which he is selling milk, in very many instances he can bring the people of the community around to a point where they will see that he is making a good milk, a rich milk, and he can ask his own price and get it; but when it comes to selling the great body of milk that is being produced in this country, he must sell it under the market conditions that exist, — he can't dodge them.

In one of the smaller cities in the State of New York a man was peddling milk which tested 3.2 per cent of fat at 5 cents, and a man who had registered Jersey cattle bottled his milk and sold it for 6 cents; it was made clean, didn't have any bad flavor, it was rich, testing at that time in the winter 6.2 per cent of fat, and he was delivering it at 6 cents. In one week he lost seven customers, two of them professional men, who stopped, they said, because they couldn't afford it; and they began buying of the man who gave them 3.2 per cent of fat for 1 cent less. What a display of wisdom!

Hon. Wm. R. Sessions (of Springfield). The speaker advises us to give people what they want, and are willing to pay for. I got up one morning a little earlier than usual. I have my milk from the milk peddler, and as I was going to take a train I saw the peddler on the street. My nearest neighbor wouldn't use anything but bottled milk, and paid a cent more, and wondered that we were willing to run such risks in buying it from the can. Their peddler was on the street preparing to go into the house, and I noticed him filling his glass bottles by turning out of a can, — the same can from which he delivered milk to me for a cent a quart less.

Mr. Dawley. Such practice should be made a crime punishable by law.

The Chair. I have had a little recent experience in regard to what people want to pay for milk, and I believe they want to buy it as low as they can. The first of October I put up my price to 7 cents, and to those who wanted to buy it from the can I delivered for 6; the first three days I lost 100 quarts of bottled milk. They would rather take it out of the old-fashioned can than to have bottled milk at a cent more a quart.

Mr. W. A. Kilbourn (of South Lancaster). I have been much interested in the subject of this lecture, but I am sorry to say that the gentleman has presented conditions that are not believable. He speaks of Mr. Stewart's price of 20 cents, which I should judge was a fair price for milk produced under his conditions; but 20 cents is prohibited to the people who want pure milk. And he says that people must meet the producers half way. Well, suppose they do meet them half way? We will say half way between 8 or 9 cents and 20 is 15; they must pay 15. But 15 is prohibited, as these men who tried raising a single cent have found a single cent is too much. Now, it does seem to me that we can have some conditions by which milk of good quality and satisfactory in most ways shall be furnished at a moderate price, — perhaps a moderate advance over our present prices. Then, in regard to the ventilation he speaks of, why, how in the world, with such a scheme of ventilation as will render the air in the stable as pure as he speaks of, can the cows be kept warm enough to produce any tolerable quantity of milk? I think there are difficulties in these statements of the lecturers which we hear from time to time. They undertake to prove too much, and go beyond practical conditions. I would say that I really do not believe that one farmer in twenty can come up to the conditions which the lecturer represents for Mr. Stewart. Now, what we want in the production of milk, clean milk, sanitary milk, — certified milk, if you please, — is some method by which we shall make and deliver to our customers a quality of milk which is healthful for people and for children; and I believe it can be done by a reasonable improvement on the conditions in most of our barns. I do not believe that we had better undertake to come up to the conditions which are suggested by Mr. Stewart's price of 20 cents a quart.

Mr. DAWLEY. The only trouble is, you forgot what I said first, in listening to what I said last. If you will remember, all through the first part of the address I gave you, every single thought I tried to lay down was how the practical man, making his milk and selling it at the market price, could afford to make it a little bit better at a little higher price. We have 320,000 farmers over in New York, and Mr. Stewart is the only one in that 320,000 that is doing such fine work, and I am not at all sure that one is enough. There are many other men who can follow along the line of the work done by Mr. Wieting without spending the money Mr. Stewart is spending, or anything like the money spent at Briarcliff. Those men are making, I believe, a better milk than the average producer, and getting a good deal better price for it. Now, the point I wish to make is, that by a very slight improvement in a very small way, and work which can largely be done by the farmer himself, perhaps with the assistance of one carpenter, we can bring about a reform in milk making, not only in New England, but in New York, which I believe is perfectly practical. As to ventilation, I will say that, with 50 cows in the barn and the space I have given, the King system of ventilation will keep the temperature at the proper height. In our barn, except on three occasions when the big doors have been open for some purpose, the temperature hasn't varied 18° since the cold weather set in this season.

Mr. KILBOURN. What degree is it?

Mr. DAWLEY. We try to keep it at from 50° to 55°. The King system of ventilation will take care of it thoroughly, accurately, and almost automatically.

Mr. West. There are farmers here to-day probably keeping from 5 to 40 cows, and the inspector is going through the community and is telling them to do away with certain things that they haven't got, and also with certain things they have got. These farmers are afraid they will have to go out of business, but they don't dare stand up here and protest for fear their words will be quoted in the papers. As for the bacteria, isn't it worse for nervous women to read these reports about the millions of bacteria in milk than it is to have them live in a house with closed blinds year in and year out, for fear some germ may get in? I think the imagination of the bacteria is much worse than the bacteria themselves.

Hon. M. A. Morse (of Belchertown). That expresses my opinion to a certain extent. For the last twenty years I have heard nothing but bacteria, and I hardly dare go to the door and fill my lungs with air for fear I am filling them with bacteria, and will have consumption or some other disease. What we want to talk is, that our milk is all right, and we want the people who buy it to believe it is all right, and then they will use it; but if I believed one-half of what I hear or read about it, I wouldn't drink milk once a month, and I drink it now once a day. If all that is said about the injury of bacteria to the human system were true, I would have been dead forty or fifty years ago, and I am only fifty-two years old. If I got down to less than 100,000 bacteria per c. c., I wouldn't get any more for my milk; and if I said to the contractor, "I want 4 cents for my milk," he would say, "Keep it at home." What we want the people to know is, that we are making a good thing, — and we are, — and then they are going to use more of it. If those who lecture and those who write will fill the city papers full of the nutritious value of milk, and that it is actually cheaper than meat as a food, and that we are making a good thing, we shall sell more, and the demand will govern the price. We have been talking, but we commenced at the wrong end. What we want to do is to let the world know that we are doing just what we are doing, — that is, making a good thing, and a wholesome thing, and a thing that doesn't kill babies. I heard a lawyer in Boston say once, — a great, fat, greasylooking fellow who had more in his mouth than above his mouth, — that 3,000 babies in Boston died from drinking milk from cows. When that man was questioned, he couldn't give a reason that could be taken in court that would show that one baby died from drinking milk, — not one, — and yet he made that statement. Now, as Brother West says, you let these statements appear in the papers, where these nervous people will read them, and then you tell them that the milk is all right, and are they going to believe it? Not much!

Mr. Dawley. We find, following this campaign for a cleaner milk in New York State than we have had on for twenty years, that in the greater city of New York, where we get the figures of these things, the consumption of milk per capita has increased nearly three hundredfold in those years. I want to say, friends, if you have dirty milk, don't tell people you have clean milk. Do as I say in my remarks, — a good promise, well filled to the dot, is worth more to a man's reputation than the broadest claim that could be disproved by a city bacteriologist. Let us all make good milk, — just as good as we possibly can. If a man will make his product just as good as he possibly could, make it right, he will be apt to get good returns. The thing that too many men are up against to-day in this matter of production is the fact that the dealers do not discriminate between the farms where the conditions are the best and those where they are the poorest; and the man who makes milk under filthy conditions gets just as much per pound at the shipping station as does the man who takes the very best possible care of his milk. That is unjust, and will not be true much longer.

Question. Will you explain the King system of ventilation?

Mr. Dawley. Briefly; I cannot enter into the whole thing, because we haven't time, — it would take a lecture itself. The King system of ventilation is one whereby we take advantage of the outside currents of air in changing the air of the stable. In the first place, the stable must be practically absolutely tight; you cannot otherwise install the King system with success. Supposing we had a flue running right up here [indicating], a room this size, with 30 cows in it; it would want to be 3 feet wide and 1 foot deep. Down here is an opening that can be opened an inch, or the whole panel, or anything between, — a tight-fitting panel. The intakes should start on the outside, back a ways from that, with an opening in the outside of the wall out through there [indicating], running up through the wall and opening up close to the ceiling. Those intakes should be open all the time, and the amount of air which is sucked into the barn or is forced into the barn should be such that the temperature and purity of the air in the barn is kept as you want it. Here at the ceiling again should be another opening in this flue, which runs out, that to be opened on hot, sultry days, when you find the stable is too warm. All the heavy gases and impurities are supposed to be lying near the floor. That flue should continue up, following along to the roof of the barn, but with insulated front, running up to a peak, with a little chimney on it. You want a good, strong draft; and if you get that, with that flue and everything made perfectly tight so it doesn't leak at all, the King system will work well, providing you have intakes enough. You should have a large number of intakes; I would have four flues in a building of this size.

QUESTION. You also see that the flue is cleaned from any cobwebs that may get in there?

Mr. DAWLEY. Yes; clear from cobwebs and dirt.

Mr. FRANK B. ALLEN (of Springfield). I have heard with a great deal of interest the lecture of the morning, and it is on just the right lines. What we want is cleaner market milk. You can't get clean, wholesome milk out of the stables we have within a radius of 10 or 12 miles of Springfield, even after inspection. Inspection has done good work on many farms, the farmers having had their attention brought to the conditions surrounding their places; and we are getting this year here in the city of Springfield a better milk by 25 per cent than we did in former years, through the efforts of the Massachusetts State Board of Health, which led us to pay attention to our conditions here, and that is well worth the endeavor. It has cost our farmers but very little, probably a dollar or two, or three or four in some cases, probably, whitewashing.

Question. Do you get any more money?

Mr. Allen. They don't need any more; they were doing what they had to do to get the prices they were getting. It isn't costing much more. A farmer says, "If I must whitewash this stable, if I must clean out my stable every day, I ought to get more for my milk;" but the old-fashioned way of making that milk wouldn't get it to market and give satisfaction. You show me a man who is clean in his dairy and who takes care of his milk after he gets it, and that milk will go to market and then to the customer and give satisfaction, — perfect satisfaction. That man ought to get more for his milk than the slovenly farmer, — the farmer who doesn't take care of his milk and keep it clean. Speaking of bacteria in milk, I know one dairy tested a few days ago by Dr. Emerson. He exercises cleanliness all the way through; his utensils are cleaned and his cows well cared for, and his test was down to 5,000. Dr. Rose told me yesterday that, if we get our milk test down to 10,000 bacteria, we are doing a good deal; but this dairy was down to 5,000, and it tested 4.6 butter fat. It doesn't cost him much more; he is a little more careful at every turn, of course, than the careless farmer. What we want to educate ourselves to is cleanliness in the utensils and cleanliness in the stable, and if the milk is produced under similar conditions, we will have a good product for our market. I think the thoughts of the speaker are most excellent; they are right in the line of progress. This asking a price for something we haven't got we don't want to do. What is the use of setting a price on milk, when you haven't the milk, either in cleanliness or quality? I believe with Senator Morse in some things, but we cannot preach that our method is all right when it is all wrong. We can't successfully impose upon the public, — we can't do it. We want to produce the milk and have it all right, and tell them it is all right, and make them pay for it.

Mr. Morse. I want it understood, gentlemen, that farmers are honest. When they say it is all right, it is all right. You get some milk from the town of Belchertown, where I live; if I went home and told the farmers to get their milk out good and clean and nice, so there are less than 10,000 bacteria in it per c. c., will you give them more for their milk? Can I go home and say to them that you will give them a bigger price?

Mr. Allen. I do think this: that, if the public have a guarantee, as you might say, that this milk is better inspected, that these farms are open to inspection, all the handling of the product is open to inspection, that it is regularly inspected, perhaps, something that is guaranteed to them, we would get a better price for milk. I think there is no question about it but the thing to-day is a gigantic sham. While we have some good farmers who do it nearly right, we have, I am sorry to say, a great many who are very shiftless about it. And it isn't right. I know this is quite contrary to the general farmer's idea. He hates to be driven; he hates to have any authority on his own plantation tell him he must put up a partition, or clean out every day, or sweep the cobwebs down once a year, or do something of that sort. It is right against the grain of the New England farmer, for if there is anything that he is lord over, it is the square acres of land he owns and operates. But it is as Mr. Dawley says: we know that by carefully handling the product and minimizing the bacteria it is more healthful, particularly so to babies. Of course we old fellows who are hardened to it can eat a good deal of bacteria of different kinds, and it won't affect us; but the children, with their susceptibility to diseases of all kinds, cannot do this. It is very important to them, and I believe the people are ready to pay for it. Dr. Rose told me yesterday that he was interested in a milk company in the eastern part of the State, and that they are getting 6 cents a quart for the milk, and they furnish the producers 5 cents, and 6 cents where accurately inspected; and the people are willing to pay 10 cents. I think the people of Springfield, if they are absolutely sure they are getting just that quality of milk, would be willing to pay for it; but who can guarantee that quality?

Mr. Sessions. There are two sides to this question, of course. I am anxious to have good milk provided for our consumption. The farmers are some of them careless, no doubt, but as New England farmers they are willing to do pretty nearly the fair thing; and I believe they tell the story in this way: the retail price has been raised 1 cent a quart in Springfield by the leverage that has been brought to bear on the matter, at a meeting of the dealers, that the State Board of Health is requiring more from the farmers, feed is higher, help is higher, it costs more to make milk, and the farmers are desiring and demanding more for milk, and they must raise the price 1 cent a quart. They raised it, and they paid the farmers ¼ cent, and took the ¾ themselves. Mr. Allen, although the manager of the co-operative company, really represents the milk peddlers in this statement here. Now, as I believe, the farmers would be willing to take these greater pains and be compelled to do certain things, provided the public, the peddlers, or whoever it is that controls it, were willing to consider some of their efforts in the money line. But, as it is, this community is in the grip of the peddlers, who get the ¾ cent raise when it doesn't cost them one iota more to deliver it, while the farmer has to take the ¼. I am not a farmer, but I was once, and my sympathy is with the farmer; and I believe the farmer is entitled to more than he gets of it.

Mr. Morse. The brother says just right. If I can get 1 cent a quart more for that milk before I leave this city, I will buy a white suit and put it on before I milk. We want to do everything that is right, but we want pay for it, — that is all.

Mr. Allen. Just a little in rebuttal: I am superintendent of the Springfield Co-operative Milk Association, the corporation of farmers. Many people get a wrong idea of this milk business. My prices have now advanced 1 cent a quart; most of the wholesale milk, ½ cent a quart. Furthermore, it takes time to work out your 6-cent tickets; it takes at least three weeks to do that, and we have advanced in our particular institution ¼ cent a quart, on the strength of advanced prices. A great many people think that is a good clean cent a quart, and it is not so. The wholesale price is advanced but ½ cent, and we don't know what we shall pay this next month, — we may pay 3½ cents at the door, clean cans. Take all your milk, every day in the year, under all conditions, no stipulations: you readily see the advantages of the co-operative movement right in Springfield. You Boston people know what it is to be all tied up with something, you don't quite know what. In the town of Enfield I asked the farmers what they were getting for milk, and they didn't quite know, — didn't quite understand the rules connected with their contracts; and that was the situation in Springfield before we had control. So I think Neighbor Sessions, while he means well, has misinterpreted the status of the case.

Mr. Sessions. We know we pay 1 cent more a quart for milk.

Mr. Allen. There are other conditions. Milk isn't our entire business; we have a great deal of cream and a great deal of butter. Butter in New York to-day is 32 cents a pound; we are paying our farmers on that basis. We are selling butter in Springfield for 32 cents a pound, wholesale. Now, where is your profit? I say that is the condition to-day; I don't say it is all the time, but that is just our condition to-day. So you see conditions alter cases. The farmer making milk will say that isn't quite fair to burden him with the butter; but what can you do? We don't want the fancy barns, — I don't think the speaker wants those barns, — unless we can afford them; but we want clean, wholesome milk, — nothing more. It isn't the farmer who produces good, clean milk that we criticise, but the unclean farmer, who is too lazy to sweep off the cobwebs from his ceiling once a year, — those are the producers we have trouble with. Take the man with a reasonably clean stable, and his product will come to the creamery and make good butter; but, on the other hand, many times you can taste the barn in the butter and also in cheese; he brings the stable right along with his butter, and it isn't just relishing, I think.

Mr. Dawley. There are one or two things I want to say before the discussion is closed. I want particularly to commend the idea of stable scoring. Over in our State we have gotten out a score card which covers not only the stable but the milk product made in that stable; and we have found, by going to those who are producing milk, particularly to a body of men such as I judge are supplying this co-operative society here, that it gives good results. When you score the stable, take the man right with you, and have him help score it. Here is that gutter with the manure in it; suppose that gutter was absolutely clean, you would call 20, perfect; but, being dirty, how much would you take off for it? You will find the farmer will be more severe and critical than yourself in scoring it. He will take so much off that there won't be anything left. Take the manger: suppose, if it was all swept out clean, just as you want to have the kitchen, it would score 20 for perfect; how much would you cut it down for not being clean? Nine times out of ten the farmer will cut it heavier than the inspector would. Look overhead at the ceiling, and if it is like some, unfortunately, there are rails thrown over the beams and the hay is thrown right on the beams, and the dust is going down a little, and there are a good many cobwebs up there; and you say, "Suppose that was scored, Mr. Smith, how much would you cut it?" Again he will cut it more severely than you would. I know, because I have been out with them in this very work. I am a farmer myself, and my sympathy and business interests are identical with yours. Now, the trouble with many of us is, we don't see things. A hinge gets loose, and we go by a hundred days, and wouldn't see it; but if it was our next-door neighbor's, we would notice it the minute we got in the barn. A gate gets loose, and remains so six months; and if we happen to go to our neighbor's, and see the same thing, we wonder what is getting into that man, — is he going down hill, or what, that he doesn't mend that gate? We don't see ourselves as others see us. The one thought I want to leave with you is this, — just see yourselves as others see you. Every man who is making milk for the market in Massachusetts should have this for his prayer, "Oh, Lord, help me to see myself as other men see me."

Adjourned.

AFTERNOON SESSION.

The afternoon session was called to order at 2 o'clock by Secretary Ellsworth, who introduced Mr. John Bursley of West Barnstable as the presiding officer.

The CHAIR. This is a bit of surprise for me, but I will do the best I can. I assure you the subject before us is one that all of us who have anything to do with agriculture here in New England or Massachusetts are interested in, — the subject of "Grass and clover production," by Prof. W. D. Hurd, Acting Dean, College of Agriculture, University of Maine. I now have the pleasure of introducing him to you.

Professor HURD. I listened with a great deal of pleasure this morning to the discussion on sanitary milk production, and I noticed in the discussion of this subject one thing that most of the Massachusetts farmers were saying was this, that they ought to have a higher price for milk, — or at least all the arguments tended in that direction. Now, it seems to me — and I will try and bring it out in this paper — that it doesn't make any difference whether we get a higher price for our milk, or lower the cost of production. It seems to me we can do the latter in all the New England States by paying attention to the feed.

GRASS AND CLOVER PRODUCTION FOR NEW ENGLAND.

BY PROF. WILLIAM D. HURD, ORONO, ME.

I have been invited by your Board of Agriculture to speak to you on the subject of "Grass and clover production," — one of the most important topics that we could consider in New England agriculture. When you invite a person from another State to come to your meeting, I realize that you want him to speak to you of what he is doing, what methods he is using in order to make successful work out of what he is attempting to do, rather than to bring to you the work of others. So, without any apology for frequent reference to our own work, I shall try and relate some of the principles we put into practice in our grass and clover production in Maine; and in doing this I shall not resort to abstract scientific considerations, but shall speak of a few of the things that we have found to be fundamental in our work. Matters of detail, and perhaps methods, too, differ under different conditions; but there are certain general principles underlying the production of these crops that are as true in Massachusetts as they are in Maine. Perhaps I shall not bring a single new thought or idea to many here present; but if, by repetition of oft-repeated phrases, we can in any way increase the hay production both in quantity and quality, the mission of this paper will have been accomplished.

Massachusetts is agriculturally largely a dairy State. The greatest desire of the dairyman is to produce sufficient feed for his dairy herd; and this might well be his first ambition. In our State I know many are practically making a failure of the dairy business, because somehow they have become possessed with the idea that it is cheaper to buy western feeds than to raise feed for their stock on the farm. I have no patience with this talk, so often heard, and have yet to hear of a farmer who has plenty of land making a success of farming and the dairy business who bases his work on that assumption. The so called "worn-out" farms of New England are fairly clamoring for more and better tillage. It is a cardinal principle of good husbandry that permanent agricultural prosperity consists in raising crops on the land, feeding these crops to animals, selling the animals or their products, and returning to the soil in the shape of manures and fertilizers much and in some cases more than has been taken out by the crop.

If I were speaking on feeding the dairy herd, I should certainly not overlook the matter of silage — preferably corn silage — as a primary factor in cattle feeding; for in most instances, while dairy work can be carried on quite successfully without a silo, it can be carried on much more successfully if silage is used.

It is a common practice to speak of grass and clover together, — I suppose naturally because both of them are sown, cut, cured and fed in much the same manner. Grasses on the one hand and clover on the other are two distinctly different families of plants; they demand different treatment from seeding time to feeding time, and for this reason I shall speak of our methods of producing each separately.

Our problem is much the same as that of any farmer. We have a large dairy herd and considerable other stock to feed. We are after large crops, and at the same time are striving to improve the fertility of our land, rather than to "run it out." While we are able to produce 4½ tons of cured clover hay to the acre, we do not use excessive amounts of fertilizers or expensive methods. We are not experimenting farther than to settle for ourselves the question as to the best treatment of our land. Our land is a heavy, late, poorly drained clay, with a hard clay subsoil, so that you will at once see that our conditions are not ideal, — perhaps not quite so good as those on the average New England farms. In other words, we believe that our practices are such as can be profitably followed by any New England farmer.

The last census taken by the United States government shows that in Massachusetts in 1900 hay and forage constituted 77 per cent of the total amount of crops raised. This same census shows that in that year there were 4,065 acres of clover, yielding 5,604 tons, or 1.13 tons per acre; it is also shown that there were 96 acres of alfalfa grown, yielding 102 tons, or 1.06 tons per acre. The statistics of last year show that the average yield of hay and forage crops was 1.33 tons, with a value of $20.24 per acre. It should be noticed that these figures include other very heavy-yielding crops, such as the millets, and no doubt corn cut and fed green. To a shrewd business man — for such the farmer of the future must be — it will at once be evident that the above-named figures are not large enough to make profitable work, after cost of labor, seed, rent of land, fertilizers and interest on the investment are taken out. The remedy is obvious, — it lies in increased production.

In riding across your State during the haying season last summer I found a condition not unlike that existing in Maine, — field after field yielding apparently not more than ¾ or at the most 1 ton of hay to the acre, and that of a poor quality. In most cases the most conspicuous plants were daisies, buttercups and other noxious weeds. Of course hay of this quality is not good feed, and will not bring top prices when placed on the market. These conditions may be overcome, and grass instead of weeds may be grown if a little care is exercised and the plants are given conditions best suited to their growth. Success with any crop depends on giving a plant this chance, and in working with nature and not against her laws, as is so often done.

In our work we give attention to the following things: —

1. Proper preparation of the land.
2. A systematic rotation of crops.
3. Careful selection of kind and quality of seed.
4. Overcoming acidity and sourness in the land.
5. Careful use of manures and fertilizers.
6. Cutting at proper time and careful curing.

1. Proper Preparation of the Land.

With no crop is thorough preparation more important than with the grasses. The smallness and numbers of the seeds and the fibrous character of the roots demand a fine soil. Briefly, our preparation is this: plowing, usually in the fall, at least 7 inches deep, thorough harrowing with a disc harrow in the spring, then using a spring-tooth and a smoothing harrow in preparing the seed bed, rolling if necessary to crush lumps, but lastly leaving a finely pulverized surface with a dust mulch, to prevent such great loss of water by evaporation. A good plan to follow is, when you are very sure you have harrowed enough, harrow once more, and you will be well repaid for your labor in the increased germination and growth.

2. A Systematic Rotation of Crops.

One of the chief reasons that the hay crops are not larger, and that what we do have in a majority of cases is poor in quality, is the fact that the land is kept in grass too long, and is not reseeded often enough. I know of fields in the neighborhood where I live that have not been plowed or reseeded for twelve or fifteen years. Now, no man in this or any other country has been able to carry on farming successfully by the growing of one crop year after year indefinitely. I need not discuss in detail at this time the advantages of a good crop rotation. Every farmer needs to do this in order to produce feed, — raise occasionally a crop which in itself will yield money; and he should also eternally have in mind the improvement of the farm. There are three conditions absolutely essential in order that plants may grow. They are heat, moisture and air, or, more properly speaking oxygen. Now, in this practice of allowing fields to remain in grass so long, two of these conditions are injured, if not absolutely destroyed, — that is, the moisture-holding capacity of the soil and proper soil aeration. When you realize that 1 pound of dry matter in hay has required from 250 pounds to 400 pounds of water in order to grow, the importance of the water-holding capacity of the soil becomes evident. Continued cropping without turning under green crops, or the addition of vegetable matter in the shape of farm manures, soon removes all the humus from the land, and the soil becomes simply so much "dirt," incapable of retaining a sufficient amount of moisture for the growth of the crop. In the same way the air is excluded from circulating through the soil; the soil becomes hard and baked. In this condition the work of the various organisms, bacteria and chemical actions, now known to be so helpful, is completely stopped or at least seriously hindered. Knowing these things, we practice on a part of our land a four or five year rotation. That best suited to our needs is: first year, potatoes; second year, corn for silage; third year, oats, or some other grain seeded to grass and clover; fourth year, and sometimes the fifth year, grass and clover.

With our land not so suitable for cultivated crops we endeavor to sow grain and reseed whenever the production diminishes below a certain point. For those fields which are not to be put through one or more cultivated crops I would recommend plowing as soon as the hay crop has been removed, and working about once a week with a disc harrow for the rest of that season. This is especially effective when "witch grass" is present.

3. Careful Selection of Kind and Quality of Seed.

There is no class of seeds which is usually of a lower germinating power or carries more foul weeds than do grass seeds. With a quantity no larger than 1 or 2 per cent of foul seeds, and if these happen to be particularly noxious weeds, many thousands of the seeds may be scattered over the farm, and cause no end of trouble. It is never safe, either, to sow grass seeds without testing their vitality. This can be done by counting out a given number, placing them between moist cloths and putting in a warm place. It is evident that, if only 50 per cent of the seeds will grow, twice as much must be sown to the acre. Poor seeds then may be doubly expensive to buy. Each farmer should examine his seeds closely. It is to be earnestly hoped that every State will in the near future provide for the efficient examination and control of farm seeds. The selection of proper kinds and amounts of each should not be overlooked. Timothy and clover are of course the stand-bys which furnish the principal hay crops; but if the land is to be used as a pasture at all, others, such as Kentucky blue grass and redtop, which thicken up the turf and are particularly hardy, should be used in the mixture. Redtop is especially adapted to moist lands.

The mixture which we are finding eminently satisfactory is, per acre: timothy, 11 pounds; red clover, 6 pounds; alsike clover, 4 pounds; Kentucky blue grass or redtop, 4 pounds. With us the alsike clover outlives the red clover, hence the reason for including it in the mixture. In favorable seasons the first crop coming from this will be almost clear clover. If the land is kept in grass another year there will usually be less clover, and then the timothy will come in. We had a good illustration of the safety in using this mixture last winter. It was a most unfavorable winter with us for clover, and consequently most of it was winter-killed. In the spring, however, a fine crop of timothy and Kentucky blue grass came on, and, instead of having a failure of our hay crop, we had a yield of 3⅓ tons to the acre.

4. Overcoming Acidity and Sourness in the Land.

In the taking of some 250 samples of soil from different sections of New England, and subjecting them to the usual tests for determining soil acidity, I have found that about 90 per cent of the older lands respond to the tests. There are a few sections of the east, where the soils are of a natural limestone formation, where this does not seem to be true. The four elements most used by plants are: nitrogen, potash, phosphoric acid and lime. Farmers buy large quantities of the first three of these, and utterly neglect consideration of the need of the latter. Grasses, and especially the clover plant, thrive best when a sufficient quantity of lime is present; and I know from considerable experience that a large number of these unproductive soils may be greatly improved by the judicious use of lime.

The ash analysis of clover and timothy shows that these crops use potash, phosphoric acid and lime in the following proportions: —

Ash Analysis of Clover and Timothy.[1]

	Potash (K_2O).	Phos. Acid (P_2O_5).	Lime (CaO).
	Per Cent.	Per Cent.	Per Cent.
Clover, ...	27.20	10.66	29.26
Timothy, . . .	34.69	11.80	8.05

[1] Table taken from Snyder's "Chemistry of plant and animal life."

That lime is important is shown by these figures.

If you will examine most of these lands that have been in grass for several years, you will find, instead of a thick turf of desirable grasses, that the ground is occupied by daisies, sorrel, five-finger, and also "mossed over." When these are present and clover is absent, or when the latter comes in the first year and then dies out, it is a fairly reliable indication that such land will be benefited by lime, or ashes which are about one-third lime, and have the power of overcoming this acid condition.

When we find our land showing any of the above indications, we apply lime. Formerly we purchased it in casks, slaked it by means of water or by covering it with moist earth, and then applied from 1,500 to 2,000 pounds to the acre broadcast just before seeding time, thoroughly harrowing it in. Since farm labor has become such an item with us we have been using lime which comes in 100-pound sacks, ground fine and ready for use. As this is partially hydrated, it is necessary to use somewhat more. Of this agricultural lime we use 500 pounds more to the acre, applied in the same way.

I would refer any who are interested further in this question of liming to the excellent and extended work of the Rhode Island Experiment Station, published in bulletin form.

5. Careful Use of Manures and Fertilizers.

In this matter of the application of manures and fertilizers there is much difference of opinion ; I can only tell you what our practice is, and the reasons for it.

We do not top-dress our grass lands with stable manure. All of this most valuable material that we have is either plowed or harrowed into the soil before one of the cultivated crops, usually the corn in the rotation before spoken of. There are two reasons why we do not top-dress with manure.

Not the least of value in stable manure is the strawy material with which the animal excrement is mixed. We want this in the soil to furnish humus, helping to improve the physical, chemical and water-holding capacity. If it is spread on top of sod land the winds and sun dry it out, and in most cases it is blown about and lost. Here let me say that I believe that the greatest loss on our farms to-day in New England is in the carelessness in caring for the stable manure. Thousands of dollars' worth of this goes to waste each year, and we turn around and buy the same elements in the shape of commercial fertilizers at higher prices. We do not top-dress our grass lands with stable manure, because we feel that by so doing much plant food is lost. This is especially true of the nitrogen, — by far the most expensive element to buy. In passing from one stage to another the nitrogen of the manure goes into the ammonia stage, this gas escapes from the manure into the air, and the land fails to receive what it might. If, however, this manure is harrowed or plowed into the soil, the ammonia is taken up by the soil water, it passes through the various stages of nitrification, and in most cases is taken up by the roots and into the tissues of the plants.

In the growing of grass and clover we use commercial fertilizers in the following way (and I might say in this connection that we practice home-mixing of fertilizers entirely) : We use at the time of sowing the oats and seeding to grass and clover from 350 to 400 pounds of a mixture that will analyze 3 per cent nitrogen, 7 per cent phosphoric acid (available) and 4 per cent potash. This is enough to give us a crop of 50 bushels of oats to the acre, and to start the grass seed in good shape.

While we do not top-dress with stable manure, we do top-dress with chemicals, and are having the best success. As early in the spring as possible we distribute broadcast on the grass land a mixture of nitrate of soda, muriate or sulphate of potash and acid phosphate in the following proportions: not more to each acre than 100 pounds nitrate soda (15 per cent nitrogen), 100 pounds muriate or sulphate of potash (50 per cent potash), 200 pounds acid phosphate (16 per cent phosphoric acid). Some recommend the use of quantities as large as 300 pounds nitrate, 300 pounds muriate, 600 pounds acid phosphate to each acre, but at present prices these chemicals would cost about $19. We cannot afford to use in this quantity.

By this top-dressing we can keep up the production on newly seeded land, and are able to double the hay crop on lands that have been seeded for some time. In fact, the improvement is so great in old seedings that one of our neighbors who secured a bag of this top-dressing to try declared that we had mixed grass seed with the fertilizer, — grass grew where apparently there was none.

6. Cutting at Proper Time and Careful Curing.

Here again our methods differ somewhat from the common farm practice. In our neighborhood the common practice is to let the grass and clover remain standing until dead ripe. I asked one man last year why he did not cut his hay sooner, and he said, "it doesn't take so long to cure it." At that time his grass, what there was of it, was dry and dead.

On pages 249 and 250 of Snyder's "Chemistry of plant and animal life" figures are given which show that clover cut in full bloom contains less crude fibre, contains a maximum amount of protein at that time, that the nutrients of the crop are more evenly distributed, that the plant contains at this stage a maximum amount of essential oils which impart palatability, and that all the nutrients are more digestible. Beal and other authorities assert that these facts are true of grasses as well as of clovers.

If our hay crop happens to be a mixed one, there being about equal parts of timothy and red clover, we cut when the clover comes in bloom, because this plant furnishes a large amount of protein. If the crop is almost pure timothy, we cut when this is just nicely in the purple bloom. When the weather is favorable we cut in the morning, shake it out with a hay tedder before and sometimes again after noon, rake into windrows, and sometimes haul to the barn that same afternoon, or at any rate the next day. We get it into windrows or into the hay cock as soon as possible, in order to preserve the color and not allow it to get brown. By twisting a wisp tightly in the hands it can easily be ascertained when the hay is in proper condition to haul to the barn.

This leaving of the grass to ripen before cutting, as is so often done, has a direct relationship to the permanent life of the grass crop. The greatest effort a plant puts forth is to produce seeds or fruit, and thereby reproduce itself. When a grass plant produces seeds, its life is ended. Nature's way is for the seeds to scatter around the parent plant, and reproduce it many fold ; but man comes in and cuts this grass just in the seeding stage, and carries the seeds away ; the plant is dead, and noxious weeds steal in to take its place. If, on the other hand, that hay crop had been cut just in the blooming stage, the roots, not having produced seeds, would try once more, and if given proper fertilizers will produce another strong plant ; hence permanent grass lands are maintained for several years.

Hay cut at this time, cured in this way and properly housed, will come out bright, succulent, free from dust, will sell at a much higher price, and is relished by all kinds of stock.

These are some of the things we try to follow in grass production. Now, turning to that other and it seems to me much more important class of crops, namely, the clovers and alfalfa, used largely as hay, I will try and enumerate briefly some of the things we do, and our reasons, in the production of this class of crops.

There are two very good reasons why every farmer, and especially those engaged in the dairy business, should grow clover. For ages it has been known that the growing of clover had a very rejuvenating effect on the soil. Since it has become definitely known that certain bacteria have the power of taking nitrogen from the air and storing it up in the tubercles found on the roots of this family of plants to which clover belongs, the agricultural value of these plants is of great importance to us. There are no plants that I know of in northern latitudes, such as ours, which will so quickly and so effectively improve both the mechanical and physical condition of the soil as will the clovers. A second reason is, that clover furnishes a large amount of nitrogenous feed for animals, — the element which farm rations most usually lack. Whether or not in our animal feeding we are "nitrogen mad," as some one has recently expressed it, will be proven by future practices; but, at any rate, at present the money paid out for feeds is chiefly for cotton-seed, linseed, gluten or some other feeds rich in protein, and which are to be used in a so-called balanced ration. Geographical location is such that we cannot grow the corn, cow peas, soy beans and other crops indigenous to more tropical regions, so that we must turn to the clovers, which are naturally adapted to New England conditions, if we are to produce a feed rich in nitrogen.

If we are to be successful in the growing of clover as well as of grass, we must recognize that there are several ways in which clover differs in its habits from the grasses.

In speaking of grass growing I tried to emphasize the necessity of good tillage; in the case of clover I would doubly urge the need of this. Besides being necessary from the standpoint of a good seed bed, in this case it has a definite relation to the action of nitrifying bacteria in the soil. If we are to recognize these little fellows as our helpers, we must at least give them a congenial place to live, — a home in which they can carry on their operations. If these little organisms are to extract nitrogen from the air, the air surely must be allowed to circulate throughout the soil; and I know of no way by which this can be accomplished other than by the frequent use of the plow, the cultivator and the harrow, to open up the soil and properly aerate it.

Again, most of the grasses by careful fertilization can be made to grow fairly well on land in a depleted condition; not so with clover. In order to produce a good crop of this, it is necessary to have soil in a fairly good state of fertility. Knowing that a soil was in a badly "run-down" condition, I would, by increased tillage and the turning under of such crops as buckwheat or rye, which will grow on such soils, first bring that soil up to a higher state of fertility before I attempted the clover.

Thirdly, many of the grasses thrive well in rather poorly drained land; but not so with clover. It sends its roots far down into well-drained soils, bringing up plant food out of the reach of most shallower-rooted crops. It will not, however, send its roots down through standing water, and I would not recommend the sowing of clover seed on lands where the water table is nearer than 3½ to 4 feet to the surface. Not only will the plants not send their roots down, but a water-logged soil prevents proper circulation of the air, and is also death to the nitrifying bacteria, — the two things already pointed out as being essential and fundamental in clover growing.

Fourthly, the clovers are classed as "lime-loving" plants. It is almost useless to attempt to grow clover in an "acid" soil. It may thrive for a short time, but usually dies out before the second season. As nearly as can be determined at present, soil bacteria do not thrive, either, under these conditions. I have reached the point where, from our own experience and from close observation, I am almost willing to say that all over New England, except in limestone regions, the neglect of this one condition is responsible for more failures in clover production than all others put together. Clay soils are especially responsive to liming. We lime our lands once during a rotation in the way I have previously outlined.

We now come to the discussion of that part of our subject about which we know the least; and in what knowledge we do have, agriculturists differ widely. I refer to the much-discussed subject of soil bacteria and soil inoculation. While the subject itself is not very new, it has been less than twenty years since Hellriegel's discoveries have been made known, and since which time the actual work with the bacteria and soil inoculation began. Of all the new agricultural subjects of recent times, I think this has created the most discussion of all. It has been grossly misrepresented to farmers, by clever advertising. They have been made to believe by these concerns — and I am sorry to say many otherwise reputable agricultural journals are not free from the blame, too — that all that was necessary for them to do was to secure "A vest-pocket fertilizer" or "A farmer's yeast cake," and their problems would be solved. Now, I have not the time at my disposal for an extended discussion of this subject, but I do wish to bring to you what seems to me to be the real status of soil inoculation and commercial cultures at the present time. I would not have you think for a moment that I am urging farmers at present not to have anything to do with this, for I am not, but I do want to say that, in the light of all I can find out, the "commercial culture" has not reached a state where farmers can afford to experiment with it very much. Better leave that to the United States Department of Agriculture and the experiment stations, whose business it is, and whose funds are appropriated for the purpose of working out such problems.

That a soil which does not contain bacteria of a certain kind can be inoculated with the desired bacteria has been proven by the work of the New York State Station at Geneva, Professor Butz of Pennsylvania, and others, without a doubt. That the methods used during the past three years, of sending these bacteria over the country on cotton and other forms of commercial cultures, has been proven a failure in fully 95 per cent of the cases, I think, without a doubt.

The thoroughness and completeness of the Geneva work and the results obtained are worthy of brief mention here. The Geneva station procured from the United States government and from four prominent seed concerns, widely separated, packages of cultures; each culture was divided into five parts, using one part in the laboratory there and the remaining four being sent to such eminent bacteriologists as Dr. Lipman of New Jersey, Dr. Houghton of the firm of Parke Davis & Co., Professor Chester of Delaware and Dr. Marshall of Michigan. In each case the printed directions which accompanied the cultures were strictly followed, and much more care was given to the handling of and protecting the bacteria than the farmer could give under field conditions.

Without going into further detail, let me quote a few sentences from Bulletin No. 270 of the New York Experiment Station at Geneva: —

To make it perfectly plain that Dr. Jordan and his colleagues were not trying to prove soil inoculation a failure, he says: "There is nothing in this bulletin which should be construed as opposed to the idea of inoculating legumes with the Ps. radicicola. This publication concerns itself chiefly with the quality of cotton cultures which have been used the present season." He says, further: "Failure has followed each of our attempts to develop Ps. radicicola from the commercial cultures. The results of our colleagues, reached in widely separated laboratories, strongly support our findings."

There is a lesson for every farmer to learn and a mistake to be avoided by such findings as these.

Our United States Department of Agriculture and certain workers in it have been severely censured for much of this failure, but I believe if we sift the matter down it can be traced directly back to the people. The public is clamoring for and demands that something new be found. To satisfy this clamoring, and also to produce a better claim for increased appropriations, on which the entire work depends, new things are frequently given out as established truths in a premature way. I believe this was the case with commercial cultures, and, coupled with the skillful advertising, a good many people "bit."

Have commercial cultures failed generally under farm conditions to produce beneficial results? I have pretty decided views of my own in the matter, but let me read extracts from letters from men who have had a great deal of experience in the use of them. These letters were gathered to be used especially at this time. It seems to me that such testimony as this corroborates the statements and the line of thought that I have brought to you. I am very sure that in the fulness of time those now working and experimenting will bring forth methods useful and practical for the farmer.

In the case of red and alsike clover I believe there are plenty of bacteria of the proper kind in New England lands. The chief trouble has been that the conditions under which they best thrive have not been right. The land has either been too wet, or too sour, or too close in texture, or some other essential condition has not been favorable. Make the conditions right, and I am very sure you will have no trouble.

We are then right in believing that for these crops our New England soils will not be benefited by soil inoculation. We must give proper conditions for bacterial growth. Of course with alfalfa, soy beans or some other crop not previously grown here it is a different matter. But, instead of commercial cultures that you know nothing about, get soil from inoculated fields that are known to contain bacteria of the right kind.

Our methods of cutting and curing our clover are entirely different from those used with the grass. We cut when the heads are about one-half in blossom. The mowed clover is allowed to wilt, tedded out perhaps once, then raked and put up in good-sized bunches and left for three or four days, according to the state of the weather, to "sweat out." We handle the clover just as little as possible after it begins to dry, in order not to break off the leaves, — the most valuable part of the plant. During the morning of the day that it is to be drawn to the barn these bunches are tipped apart, the sun and wind dries the visible moisture from the center, and the hay goes to the barn in good shape. I have heard of the practice of putting the clover into the barn in a very green condition, but we do not do it. Those who do, claim great things for their method, and of course it has in its favor the avoiding of rain and showers.

My discussion of grass and clover production would not be complete if I did not say something on the subject of alfalfa. If alfalfa could be successfully grown throughout Massachusetts and the other New England States, and if fields could be obtained which would yield four or five crops continuously for fifteen, twenty or more years, as it does in the west, it would be the salvation of our dairymen. Just what is the trouble I do not know, neither have I found any one in the east who was willing to stake his reputation in answering this question. Surely it is not climatic conditions alone, for in all sections we can find a few straggling plants that have evidently been in the locality for years. I was surprised this last summer to find some growing in a man's yard at Fort Fairfield, — one of the most northerly points in Maine.

The conditions under which alfalfa will grow and thrive seem to be the same as for clover, excepting that they must be more extreme. Lands which are drained enough for clover may not be at all adapted to alfalfa. Its longer and deeper rooting system must have more soil. The nature of the subsoil, too, greatly affects alfalfa. It is almost impossible to make it thrive on a clay hardpan. A soil expert from the Department of Agriculture, who was studying the alfalfa questions all over the country, recently said to me that "he didn't care what the top soil was, it was the subsoil which mainly determined the land's adaptability to alfalfa." Water standing and freezing around and in the crowns of the plants almost seems to be sure death to the crop.

Since alfalfa is comparatively new in the east, I would not expect to find the bacteria which work on the roots of this crop in large numbers, and so would resort to soil inoculation with other soil, expecting that by so doing considerable vigor in the growth would be gained.

Here, again, it seems to me that the wise farmer will allow the experiment stations to do some work before he enters largely into the growing of alfalfa. Red and alsike clover grow so naturally and so well that if we put the same amount of time, labor and money into attempting to grow these crops that we are now putting into the alfalfa questions, we shall be far better off.

Somehow, the idea has gained a foothold that alfalfa is much better in feeding value than red and alsike clover. As a matter of fact, there is not as much difference as is usually supposed.

Table showing Composition of Clovers and Grasses.[1]

	Protein.	Fiber.	Ash.	Nitrogen Free Extract.	Fat.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Alfalfa hay, ...	14.3	25.0	7.4	42.7	2.2
Red clover hay, ...	12.4	21.9	6.6	33.8	4.5
Alsike clover hay, ...	12.8	25.6	8.3	40.7	2.9
Timothy hay, ...	6.0	29.6	4.5	41.9	3.0
Kentucky blue grass hay, . . .	10.4	19.6	7.7	50.4	2.5
Redtop hay, ...	7.9	28.6	5.2	47.5	1.9

[1] Table taken from "Encyclopedia of Agriculture," by Wilcox and Smith.

If the life of alfalfa fields is to be only three or four years, and there is to be constant effort to keep up the growth even that long, alfalfa culture will not be a success here.

I heard Mr. Ellis, one of your leading dairymen from near Boston, say a couple of years ago that he was paying $10 a ton in Nebraska for alfalfa, and the freight was costing him $10 more to land it in Boston, making $20 in all, and that he considered it cheap feed at this price. If a ton of red clover is so nearly equal in feeding value to a ton of alfalfa, and you farmers in Massachusetts can grow 4 tons of clover to the acre without effort, then you had better hold fast to that which is good, and bend your best efforts to clover production until the alfalfa problem is solved for New England.

To summarize and conclude, I will say, in your grass growing give good tillage and preparation. Rotate your crops, and don't expect your land to yield one crop indefinitely. Be careful in the selection of kind and quality of the seed. Don't attempt to grow grass on sour land. Be careful of your farmyard manures; they are the most valuable asset of the farm. Study the proper use of commercial fertilizers; cut early, to avoid running the grass out. In clover production do all these things, but be more careful about drainage, soil acidity and proper cutting and curing; and by all means don't allow advertising schemes of any kind to lead you away from giving any crop the conditions nearest to which the Creator and nature intended it to have.

I trust that the points in grass and clover production which I have presented appeal to you as being rational and practical. They are the principles in the observing of which we are able to gather into our barns 4½ tons to the acre the first year and 3⅓ tons the second year, — nearly 8 tons of valuable hay in two years. This yield is not as large as some that we hear so much about, but we do not use extreme methods or excessive amounts of seeds or fertilizers.

Aside from the minor things which enter into the management of each farm, I submit these methods to you Massachusetts men as being such as each of you can carry out on your own farms.

I thank you for the privilege of presenting this important topic before your Board, for your fine attention and interest in what I have had to say, and will be glad to answer any questions that I can.

Hon. Wm. R. Sessions (of Springfield). While the professor is getting his breath, I want to have a gentleman in the room tell us a little of his experience. He owns a patch of ground located near the old schoolhouse where I went to school, and I have known that patch of ground for sixty-five years. It was such a field as the professor has spoken of; it never has been plowed or reseeded in that length of time. A year ago he took hold of it, and I saw a magnificent crop there. I wish Mr. Bliss of Wilbraham would tell us what he did with that patch of land.

Mr. Ethelbert Bliss (of Wilbraham). It was rather a moist field, and the underground was so stony it was impossible to plow it. The grasses had become all killed out, — that is, the good grasses. I took it right after haying, and put the double-action cut-away harrow on it, and run it there until we cut the ground thoroughly, — made it quite fine. We did that several times, let it lie two weeks or so, and went over it again; I kept at it until it looked like a plowed field. Then I fertilized it, and sowed timothy, redtop and alsike clover seed. That is all I did to it, but the results were far beyond my expectations. I don't know just the amount of hay we got there, but it certainly was a heavy crop for us to grow. The second crop also was quite heavy.

Question. How heavily did you fertilize it?

Mr. Bliss. I couldn't give you the exact amount. We put on a light dressing of barn manure, also some muriate of potash and a phosphate; I think that was all the commercial fertilizer we used.

Mr. Sessions. You had as much as 3 tons to the acre there, or more?

Mr. Bliss. Yes, I think so. The field was about 7 acres, and we got 18 or 19 tons of good, dry hay, and 7 or 8 tons of rowen.

Mr. Heath (of Monson). Would the professor advise us to clover-seed a field where the clover will come in the second year itself, plenty of it?

Professor Hurd. I think in seeding down I would use whatever seed I wanted. I would use clover seed in the seeding-down mixture, and not depend upon the clover coming in of itself.

Mr. Heath. The first year, if you grow timothy and redtop, you will get a good crop, and the second year it will be a heavy crop of clover on my field.

Professor Hurd. With us it is just the other way. We get the clover the first crop; and timothy and Kentucky blue grass, and those things, the second crop; and our alsike clover will last three or four years; the red clover will last two years.

Question. How much seed to the acre?

Professor Hurd. Just about half a bushel; use, say, 11 pounds of timothy, 8 pounds of red clover, 6 pounds of alsike clover and about 4 pounds of redtop and Kentucky blue grass, the whole making about half a bushel of grass seed to the acre.

Mr. Sessions. And the professor, I believe, recommends seeding down with oats; we can't do that successfully here, I think. Our best success seems to be, like Mr. Bliss's, in seeding after mowing in August.

Professor Hurd. Yes; a good many of your men succeed well in seeding in this way, too.

Mr. Sessions. Our soil after an oat crop seems to be so loose that the removal of the oat crop and letting the sun in kills out the grass. It isn't one time in ten that we can get a catch of grass seed sowed with oats.

Professor HURD. We can do that, and get a crop of oats, and are so much to the good.

Mr. SESSIONS. About the first of my agricultural reading was in the old "New England Farmer," nearly sixty years ago, and a writer proclaimed that no man should plow when the ground was wet at all, when it was damp, but he should wait until it was dried out, for if he didn't, it would be lumpy. I wondered and wondered, for at home we preferred to have it a little moist, as it was easier for the team and pleasanter. After a while I found it was a question of soil that he was talking about, and he hadn't told us that. I think you are in something of the same predicament.

Professor HURD. We have a very heavy clay soil.

QUESTION. You find a better catch of clover if sowed in the spring?

Professor HURD. Since I have been in Maine we haven't tried it. In my home State of Michigan we invariably sowed the clover in the spring, when the ground was slightly frozen, along in March, when it was just beginning to thaw out a little. I think the climatic conditions have more to do with the catch than does the soil.

Mr. L. W. WEST (of Hadley). I never had any success with sowing clover in the fall. I think it should never be sowed after the 1st of September. I sow my clover and seed down in corn of late years, because we can't really grow a good oat crop, it doesn't pay us to, in the Connecticut valley.

Professor HURD. I suppose you have had Mr. Clark up here at your meetings, and he doesn't advocate any other crops but grass alone. We seed with clover along with the oats. The danger of seeding so late as September or October is, the plants won't get strength enough to withstand the winter.

Prof. F. W. RANE (of Boston). I had some experience looking into the seed question. Two years ago there was a large concern that bought quantities of clover seed in the west and had it shipped to the northern part of New England and sold it. It so happened that some of the men thought perhaps it wasn't good seed, and they got into more or less of a discussion over the question of clover seed. Some claimed they better get seed from Boston dealers for comparison; and it was left to me, as a sort of go-between, to find out its value. I had occasion to go down to Boston and look into some of the seed questions, particularly in regard to clover, and I found to my surprise that the clover seed sold throughout our State was for the most part of a poor quality of seed. The seed men themselves in Boston recognized that fact, and are not to blame for it. On the other hand, there are men who are buying it and who are asking for a second-grade seed, and they are not to blame for it. Following it down further, I find people are looking for a bargain in clover seed. If a man can buy clover seed 25 cents cheaper than the best seed, he buys that because he thinks he is saving something. I thoroughly believe that any man who is going to seed down 10 acres, or perhaps 5, will find it pays to take a trip into Boston, or to the market where he is to get the clover seed, and look the various kinds over and buy the very best. You can go into a large seed concern in Boston, and find that a certain clover seed has a certain per cent of germinating power, one 9 per cent, another 50 per cent, another 20 per cent, and so on. If a man sends in, asking for a certain seed, they look up what sort of a dealer there is in that section, and what the farmers in that section want to buy, and send that kind of seed. I believe where a man harrows a piece of land and gets it in the best of condition, if the crop fails, the reason may be entirely with the clover seed itself. If I were in farming, after doing all the preliminary work that is required, I would go to Boston and look over the clover seed, and get the very best seed and sow it, and I will guarantee any one who does that will get more than he is getting to-day. I think the reason for clover not doing well in many cases throughout New England is largely that the farmers themselves use cheap seed. It isn't practical. It is a big, economic problem. When we commence to pinch on the seed, we are beginning in the wrong place.

Hon. M. A. Morse (of Belchertown). What my brother says as to clover seed is true of all kinds of hay seed. I bought mine from a wholesale dealer in Palmer. He had a few acres himself, and bought the best kind of seed, and I bought the same kind. He has gone out of the business, and I am looking for some one with good seed. The Palmer dealer told me he could not sell the best seed at the wholesale store, and yet they tell you it is the best seed. It pays to buy the best seed; it doesn't take so much per acre, for one reason.

Mr. W. M. Tucker (of Monson). I spent a little time in the State of Michigan, — I think that is the speaker's home, — and I was quite surprised to find at that time that everybody was cutting a second crop of clover, and cutting it for seed. Is the second crop of clover as good for seed as the first?

Professor Hurd. The chief reason for using the second crop is, that it all matures at nearly the same time. In the first crop, some is ripe and gone; and where one crop has been cut, and the second crop comes on, you get all heads ripe at the same time.

Mr. Tucker. It looked to me a very small amount per acre.

Professor Hurd. About a half bushel; that is all.

The Chair. Mr. Dawley is in the audience. He is familiar with alfalfa-growing in New York, and I hope he will give us a few words on the subject, as everywhere I go over the State I am asked concerning the growing of alfalfa.

Mr. F. E. Dawley (of Fayetteville, N. Y.). There was one thought brought out in relation to this last question that I would like to mention first. The plant is the unit, and not the seed; and I don't believe it makes any difference whether it comes from a first or last crop, if it comes from a vigorous plant, taken from a field where the plants are well grown.

In relation to the matter of alfalfa, in our section we have been very successful with it, the success dating back something like forty years. Professor Hopkins had a whole lot of converts, in the vicinity where I am living, in regard to inoculation. I think, easily, about four-fifths of all the hay cut in the town I live in and the two towns adjoining on the east and west is alfalfa. This year, keeping something like a cow for every 3 acres of tillable land in that section, hundreds of carloads of alfalfa are being shipped out of it. The price being paid for it in the barn now is somewhere between $10.50 and $11.50, and our farmers are growing something like 3 tons per acre. So you see we are very well satisfied with it, and have nothing to complain of, and haven't very much land for sale. The last fifteen years have seen a wonderful upheaval in agriculture in that section. Some of the brightest young men we have have come back on the farm, and are doing better than those who have gone to town. It isn't a question of keeping the young men on the farm now, but getting a farm to keep the young men on.

So far as alfalfa is concerned in that vicinity, we don't realize we need inoculation. Of course we do, but the reason we don't realize it is, alfalfa hay is being gradually drawn from the central part a little further every year; the manure is spread on the fields, and, while we don't know that inoculation comes from that, the indications show that it does. Also, over in New York State we find that in most sections the inoculation is needed. Where sweet clover has been growing for a period of years, naturally, or because of inoculation, we find very little trouble in growing alfalfa, — it almost always catches there. We find, too, if you can get a start where the field is half inoculated, by turning it in while in a vigorous condition in the spring, and sowing again, after doing this once or twice, the whole field will become inoculated. If you can find a few plants of alfalfa growing in a section, if the conditions of drainage and acidity are right, I can see no reason why you cannot grow alfalfa. I believe most of the failures that I have got track of in this State and in New England have come from fields where the soil conditions are not right; and I can't quite see how you are going to make them right. We have a great deal more snow, I believe, as a general thing, than you have here; and as the speaker well said, the snow comes on very many years, as it has this year, before the ground is frozen; the ground freezes under the snow, and the snow lies there and keeps the ground pretty well frozen until well along in the spring. We find quite a difference, if we get a condition which you have found in this State, where the frost goes down for 10 or 15 inches, or maybe more, and later a part of this thaws out, and then another freeze comes and freezes down 3 or 4 inches, so there will be 3 or 4 inches of frozen ground up at the surface, and then a portion not frozen, and then beneath that some 6 or 7 inches of frozen ground, for just as soon as that ground begins to heat, that snaps that root. Three or four years ago all the alfalfa, nearly, in the State of New York went out just with this same sort of condition. Now, I don't quite know how you are going to remedy that difficulty. I wouldn't want to say to keep hammering on alfalfa, if it cannot be grown successfully here; and I wouldn't want to say to keep hammering on red clover, unless you prove alfalfa cannot be grown successfully here, for you can grow a whole lot more of tonnage with alfalfa than you can with red clover under equally good conditions, and a field will stay in from six to eight, ten or fifteen years; I have known some pieces to stay in from eighteen to twenty-two years, and they are still giving good crops. In that way you have got rid of the extra labor of breaking up and reseeding again, and that is one thing we have to guard against in New York State.

Professor HURD. I have seen well-drained soils in Maine, and you couldn't make the alfalfa stay more than a year. They have been unable to do it even on soils along the river, where they are sandy. And we cannot get several crops in New England, either; we cannot get over two, and sometimes not two, — that is, in the northern part of New England.

Mr. DAWLEY. We used to have a man in Jefferson, N. Y., who said they had nine months winter and three months late in the fall. When you come down to a condition where you can't get two crops, I don't quite understand. When did you first start to cut off?

Professor HURD. The last part of June, or early in July, probably.

Mr. DAWLEY. With us, on our farm, we commence cutting before the first of June. This year on 85 acres we were all through cutting by the 20th of June. We have to begin early, in order to get through. Another advantage, — if our first crop of alfalfa is grown and cut from the 10th to the 20th of June, it is apt to get very stalky, and if the weather is at all wet, as it usually is about that time, it is almost impossible to cure it; but by cutting it when it is greener you get a hay that I believe is more digestible, — in fact the analysis shows that it is, — and we don't have as much trouble in curing it. Our next crop is ready to cut again in about twenty-five or thirty days. Would yours be ready in thirty days more?

Professor Hurd. No; not much before the middle of August or 1st of September.

Mr. Dawley. I don't know your conditions well enough to try to answer your question. With us, in each thirty days after the time we cut the first crop we get another cutting of alfalfa that will weigh somewhere from 1,200 to 1,800 pounds to the acre, the last one from the 12th to the middle, perhaps, of September, which is usually next to the heaviest. The first is usually the heaviest, and the last one the next to the heaviest; those in the summer, with less rainfall, do not show so heavy a tonnage. In reply to your other question, there is certainly some soil condition existing on such land, that no observer can give, possibly, any competent opinion upon. The matter of alfalfa growing seems to be made up of anomalies. Sometimes you will find it growing over a good, stiff hardpan in New York State, the very thing we have been telling is of no use; and still some fellow has got the pluck to go ahead, and those alfalfa roots have gone down through that hardpan, and he has got a good catch. I think I have a list of some twelve or fourteen pieces of alfalfa grown in that way, scattered all over the State, — one in particular as old as seven years. Fayetteville is about 8 miles from Syracuse, and Syracuse is in the center of the State. The alfalfa which is grown in New York State in the largest area will begin about 12 miles east of Syracuse, and lies south of the Central Railroad, a strip of from 1 to 5 miles wide, extending practically to the city limits. There is more alfalfa grown in that section to the acre, perhaps, than anywhere in the rest of the State. There is some in the western part, but not so much.

Professor HURD. What do you consider an ideal alfalfa soil?

Mr. DAWLEY. I believe a soil where standing water is never going to come within 14 feet of the surface, and where we are sure it never does stand higher than 13, 14 or 15 feet from the surface, with a clay loam top soil, with a gravel subsoil, is pretty nearly ideal. I believe, on a stiff clay loam, with a stiff subsoil going down 4 or 5 feet, and where they are working out limestone in an adjoining field, that I can show you as heavy crops as you will see anywhere.

Mr. WM. H. PORTER (of Agawam). Then valley soil will not meet those conditions?

Mr. DAWLEY. As a general thing, I think valley soils will not make alfalfa soils unless up on a table land.

Mr. PORTER. I mean sandy loam.

Mr. DAWLEY. I wouldn't want to discourage any man from growing alfalfa, and I would try it, no matter what the soil was, if I could be sure I had the proper drainage and acidity; but I don't think the conditions in the valleys are ideal.

Prof. WM. P. BROOKS (of Amherst). I have rather by design refrained from rising, because I wanted to hear what those from other localities might say on this subject. I think our difficulty is a fundamental one, and that it is connected with our locality and its climate, and in part with the geological origin of our soils. I don't know whether you noticed, as I did, that Mr. Dawley, in speaking of one of the types of soil where he said it succeeded, said the clay loam was underlaid by limestone. At dinner to-day he spoke of an abandoned lime kiln on his farm, which he had started into activity. Alfalfa succeeds as a rule much the best where the soils contain a great deal of lime, — where limestone plays an important part in the formation of the soil. Mr. Bliss of the Department of Agriculture has been making a very careful study of the conditions in New England as related to alfalfa, and the degree of success or failure which has followed efforts to grow it in different places, and was kind enough to send me his report in manuscript. While he was very enthusiastic when he first came to see me, Massachusetts having been the first State he visited, in this manuscript he confessed himself as discouraged. In all New England he found only one locality where they were really making a distinct success with alfalfa, and that is what I think is called the Grand Isle region in Vermont, and it is a significant fact that that is a limestone district. You may say we can buy lime and put it on, and it is true an application of lime will help; it is absolutely useless to try to grow alfalfa here unless you put on plenty of lime. We might manage to grow it if deficiency of lime were the only difficulty; but I think that we are situated in the very worst climatic region for this crop. They succeed with it farther south and farther north (away up in Canada); they succeed with it farther west. They succeed farther south because they have a less severe climate to deal with; they succeed farther north and farther inland, not because they have a less severe climate, but because they may count on full protection from snow. Where the snow comes and covers the ground and remains until the frost comes out (the frost coming out from underneath), there alfalfa will live; but where the soil freezes deeply and the frost comes out from the top, it settles away from the crowns of the plants; and I have seen the alfalfa in spring standing, as it were, on stilts, and this seems to be more than the alfalfa can stand. At the college we have got alfalfa to stand well, and had good crops for one or two years, but it gradually weakens and gives place to grasses; and all I can say in conclusion on the subject is, that I don't want to discourage you from trying it, for some of you may find you can grow it, but that I am not prepared to recommend you to sow it on any large scale.

I was glad to hear the professor say something in favor of the good old clover. We can raise fine crops of that, and as long as we can do that, while we may not get as rich feed as our friends in Fayetteville, still we may manage to keep our heads above water.

In relation to good seeds, I think the biggest fool in the whole world is the man who tries to economize on seed. You can't get too good seed.

As to the question of a second crop for seed, it seems to me it wasn't answered fully. I happen to think of another point. The bumblebees are responsible for the setting of clover seed, and there are very few bumblebees in the early part of the summer, and not very much seed sets. It would be a great mistake to try and get clover seed from the first crop.

Something was said about the impossibility of raising good grass crops in permanent mowings. Permanent mowings are not to be indiscriminately recommended. Rotation is better than continuous planting, as a rule, although many have proved, as we have at the college, that you can raise very profitable crops of hay continuously. On the grounds of the college there are about 30 acres lying in the midst of our buildings, most of which I know have not been plowed for twenty years; but the average crop is very good, this year being between 3 and 4 tons to the acre. I was a little surprised to hear the speaker refer to a decline in the stock of humus in the soil kept permanently in grass. I happen to remember an old saying, common among English farmers, which impressed me strongly: "To make a pasture" (permanent grass land in the English sense) "will break a man; to break a pasture will make a man." In other words, when land is kept permanently in grass under suitable conditions, I think it generally improves; and I was not much surprised to hear of the big crops that my friend got when he gave the fertility which had been accumulating in that soil for sixty-five years or more a chance to become available. I think land improves when kept constantly in grass, although the practice of so doing is not, in my judgment, always to be recommended. We keep this land continuously in grass chiefly because it is managed in part as a park, and we like the looks of it better in that condition.

I was interested in what the speaker said concerning the quantity of fertilizers used on the college farm in Maine. From my point of view they are very small. He evidently has a soil which has a great deal of potential fertility, and by tillage he makes this available. I speak of this simply to point out the fact that unless you have soil of this great natural strength you cannot expect to obtain such crops as he speaks of without using fertilizers more liberally. You may know about what we are using at Amherst, about what I in general recommend; but, at the risk of bringing forward a matter which it is quite unnecessary to speak of, I may say that I have very great confidence in an annual application of about the following materials per acre: basic slag meal, 500 pounds, largely on account of its lime, also because it is a cheaper source of actual phosphoric acid. Phosphoric acid in slag can be purchased for about 3 cents a pound; it costs in acid phosphate in the neighborhood of 5 cents a pound. In the slag meal, 3 cents a pound is the cost where you reckon the acid to be the only element of value, and allow nothing for the lime. If you make an allowance for the lime, and deduct that, the actual cost of the phosphoric acid would be considerably lower than I have stated. Basic slag meal, then, about 500 pounds, as a source of phosphoric acid and lime, and as a means of keeping the soil in sweet and good condition. Then, potash at the rate of about 150 pounds per acre, of high-grade sulphate, or 300 pounds of low-grade sulphate. I should say always on Massachusetts soils either the high-grade or the low-grade sulphate, rather than the muriate, if you wish to produce hay rich in clover; if you wish to produce timothy to sell, use the muriate. I know there is a great difference in the proportion of these two species, according as you fertilize. Taking a series of years together, you would be surprised at the amount of difference. If you made the comparison for a single year only, you might not see any considerable difference. If you continue such application of fertilizers as suggested, you will soon bring your land into such condition that it will produce a very superior grade of hay. But, in addition, I should generally apply about 150 pounds to the acre of nitrate of soda. Professor Hurd has referred to their using of 350 pounds in Rhode Island in some cases; I believe it is reported that they have found that even 400 pounds grew a more profitable crop than any lesser quantity. How is this difference to be accounted for? All the parties concerned are honest men, and are telling the truth as they have seen it. I think it must be due to the difference in the soil. There may be soils in Massachusetts where you can use 200 or 300 pounds of nitrate in connection with other materials with profit, though as a rule you cannot use so much nitrate. This year we tried some experiments, using different amounts of nitrate, and there was but little difference in the crop. It was substantially 3 tons to the acre for the first cut, and a little over 1 ton per acre for the rowen; about alike, whatever the amount of nitrate used. Where the 250 pounds were used, the crop was practically the same in amount with the crop where 150 pounds were used per acre; and on the larger quantity of nitrate the quality was inferior.

QUESTION. When do you apply the fertilizer?

Professor BROOKS. This mixture of materials we usually apply early in the spring; not excessively early, but about the time you think the weather is really settled.

QUESTION. Which is the stronger, 150 pounds of high-grade or 300 pounds of low-grade of sulphate?

Professor BROOKS. They are of equal strength as regards the actual potash.

I want to comment a little bit on one statement of the speaker in reference to inoculation of the soil. He really qualified his original statement about as I propose to qualify it, but he did it so briefly that I think you may not have fully understood. He said the theory was a good one, but the fact is, the method of making the culture has not been perfected. Now, I say the theory is not a good one as regards any of the crops of the clover family which we have long cultivated, and I say so because nature has provided for the abundant production and distribution of these bacteria herself. Mr. West will agree to this, I know, for he has gradually had it driven into his mind that it is awfully difficult to keep bacteria out of the milk, — I don't think you can, for I believe they are everywhere. I know the claim is made that these bacteria produced in the laboratories of the government are more energetic. They are a sort of thoroughbred bacteria, and therefore much better than the "scrub" bacteria grown in the fields; but that is a claim that has never been proved anywhere. Mother Nature's bacteria are all right, and there is enough of them everywhere.

I would like to hear from any farmers present touching clover. The speaker has said alsike clover is longer-lived than red clover. In Amherst it is precisely the opposite; red clover persists longer than the alsike when we sow both, and also gives more rowen. There is no doubt a reason why these two plants behave so differently in the two localities; perhaps the reason will come out, as the result of my remarks. I should like to hear from any farmer, who is in the habit of sowing the two kinds of clover, as to his experience.

QUESTION. Why will the alsike come into a meadow without any sowing of the seed?

Professor BROOKS. Because the seeds are there, and because the conditions have been made right. One may be inclined to question that the seeds are there, or may not understand how they can be there; but it is known generally, of course, that many of our seeds are capable of retaining vitality for very long periods when buried in the soil. Clover is peculiar in that respect; it seems to have been designed by nature to do precisely that thing; and a very brief statement of a personal experience in Germany may interest you. I visited, among other places, the principal experiment station in the world for testing seeds, and was shown about by old Professor Nobbe, the pioneer in work of that sort. He took me to a big case and showed me a lot of little vials of water, and in the water were little, yellowish seeds. He said they were clover. He added: "When I began to test seeds for farmers, I found a good many clover seeds didn't grow; they looked all right, and I wondered why they didn't grow, so I cut them open and looked at them; they were all right, the meat was there, the germ was there, and still they didn't grow. For some time I couldn't understand, but after a while I found out that the seed coat of the clover is in a good many cases prepared by nature to resist the taking up of water; it is made waterproof." He said: "You see those clover seeds in those little vials; some of them have been there twenty years; some of them sprout and grow every year, and as fast as they do so, I take them out; but I don't expect to live long enough to see all of them grow." If they live that length of time in water, you may judge what they might do in the soil.

Mr. E. P. Williams (of Ashfield). My experience is, I don't get much until the second year. The second year seems to be a good cut for hay and clover both, and after that I don't see much alsike clover, but the red clover up on the hills comes up itself; you will see it all over the fields one year, and the next year hardly any.

Professor Brooks. When do you sow your clover seeds?

Mr. Williams. Usually in August.

Professor Brooks. That is about the time we sow them, but we get much more the first year than the second.

Mr. Williams. I know Mr. Wilson sowed alsike clover a little earlier than the rest of us, so the bees could gather the honey, but he said himself he didn't get any honey until the second year; I don't know why, but the second year it came up and he had a large crop.

Mr. E. P. Parmenter (of Springfield). The experience I had in clover is this. The alsike on the elevations at which we have grown it will run out in two years; the third year there would be a sprinkling of the red clover; it would be principally in bunches, not so you could call it a crop, but while the alsike was entirely gone, the red clover would still survive for another year or two in a limited way.

Professor Hurd. There is one point I am glad Professor Brooks brought out; that is, this matter of a permanent meadow. I didn't mean to say that we have no lands outside of those we have in four-year or five-year rotation, because we have; but I was driving at this: in our State the common practice is to cut hay each year, and put very little or nothing in the way of fertilizers or manure on those meadows. We have a piece of about 8 acres on our campus, much the same as Professor Brooks speaks of, which, for appearance sake, we keep in grass (for about ten years now) with top-dressing of fertilizers. Instead of robbing the land all the time, I want to recommend putting back something in the shape of fertilizers, which we do right along. If I didn't make the statement, I will now, that we do that very same thing.

Mr. Sessions. In calling out Mr. Bliss, I wanted to emphasize the fact that some of our old meadows among the hills that have never been plowed, where the owners feel they cannot plow them on account of the stone never having been taken out, may be brought into condition without plowing by the use of the harrow.

Mr. West. I think in my town we have some alluvial soils which haven't been fertilized perhaps for one hundred years, and as a general rule we get two crops from them. On some of it clover has been sowed years ago, and some years there will be considerable clover, and then it will skip a year, and the following year there will be clover again.

Mr. Wm. H. Bowker (of Concord). I would like to ask Professor Hurd if he has made a comparison of the amount of nutrition that is taken out of the soil by a fodder corn crop — field corn or fodder corn — with that of the clover crop. I have experimented with a farm twenty-two years, with which I was acquainted ten years earlier. We used to get very good clover. We never could get the alsike to stand, while the red clover stood very well; but by climatic conditions, or for some reason or other, our clover crops were killed out very largely, I think by ice forming on the surface, until we gave it up and went to growing corn, — ensilage corn and fodder corn, — believing we would get more out of the soil and be sure of it every year than by raising clover. I suppose the root system of the corn plant is a very extensive system; it doesn't run as deep as the clover, but the rotting of the root system must have something to do with the fertility of the soil. I wonder if any experiments or tests have been made as to the actual nutrition taken out by a good-sized ensilage crop, or corn, and also the amount of fertility that is given by the rotting of the roots, as compared with the clover. The corn crop we are sure of, but not the clover crop up on the hills of Worcester County; and I think there are Worcester County farmers here who will bear me out in saying we are not always sure of it, and I think we should bank on the crop we are sure of, and not on one that will go back on us.

And another point, before I sit down, in reference to the application of fertilizers or plant food for grass crops. I was brought up on a light soil, and we found we could top-dress that in early spring and get good results. When I took this Barre soil, which is a heavy soil, I used to top-dress with chemicals in the early spring, and I got a fine growth of grass, what the farmers sometimes call "fuz;" but when I top-dressed later, the last of May, I would get a stronger growth of grass. So on the Barre farm I adopted the method of top-dressing late, and Mr. Ellis has followed it since.

Professor Hurd. In answer to the first question, Mr. Bowker knows I am not engaged at all in experiment station work, but I do not doubt that figures can be found to answer your question. I haven't any at the present time, but I am very sure such figures could be found.

Now, with heavy clay land, up at the University of Maine, we top-dress with these chemicals in the spring just as the grass is beginning to green up a little bit; and we have most excellent results in getting good, heavy, tall grass, and not this "fuz" grass, as you call it.

Professor Brooks. In answer to the question of Mr. Bowker, I will say that this question as to manurial value was one raised quite early in experimental history, and in the early reports of the experiment stations you will find this matter was dealt with quite extensively. While I won't attempt to reproduce the figures, there is one point which should be brought out here, and that is this, that whatsoever the corn residue leaves behind came out of the soil to begin with; but in the case of the clover — an important distinction — by far the greater part of the value left behind in the stubble and roots came from the air under like conditions. The roots of the corn get all the nitrogen from the soil to begin with; the corn has no ability to take it from the air. It is a thing that has been very carefully studied, and no one has been able to show anything to the contrary. I am willing to admit this much, that undoubtedly there are great fields of knowledge which we have not yet explored, and I do not say that it may not some time be found that some other crops than those which we know now draw nitrogen from the air; but I am perfectly sure that up to the present time there is no reason for the belief that corn can do it. This is true, however, — and this makes corn one of the most valuable of our crops, — that it is capable of making a good crop with a relatively small application of nitrogen through the soil.

Mr. **Bowker.** Take the original formula of 77 pounds of nitrogen, 31 pounds of phosphoric acid and 80 pounds of potash. We found, by carrying that on for a number of years, that 77 pounds of nitrogen would throw the corn all to stover, with no seed. We gradually reduced the nitrogen until we got it down to 4 per cent, increasing the phosphoric acid and increasing the potash, and the result was we grew better corn with the less nitrogen than we did with the larger amount, showing that the corn evidently assimilated the nitrogen from some other source. If through the air or soil, that is one way; or through the leaves, that is another way. I think the corn crop is a great gatherer of nitrogen; not so much as clover, however. But I believe in New York State, where they have snows, a blanket, to cover the clover, they ought to grow it; but otherwse it is a speculation, as it is on the Barre hills. I question whether we had not better stick to corn.

Professor **Brooks.** No man can outdo me in my admiration for the corn crop; but there is no evidence — and this is the point — to which any one can point that corn is able to make use of nitrogen from the air. It stands out more and more clearly, the more I experiment, that corn is capable in a very unusual degree of making use of the natural stores of nitrogen in the soil. This is connected, I think, without any doubt with the season when it takes its growth. None of our soils are so poor but they contain considerable organic nitrogen; and corn makes its growth by drawing upon the natural resources of the soil, but there is no evidence that it can draw from the air. It is true that it can be grown by applying very little nitrogen in the shape of manure to the soil. I could take you to a plot in Amherst where for nineteen years we have applied annually only muriate of potash and a phosphate. That field was in corn in 1903, at which time it had not had any nitrogen whatever applied to it for about fifteen years, and the crop of corn was at the rate of 57 bushels of shelled grain per acre. But clover has been grown there on two or three rotations.

Mr. W. O. Parmenter. I am very glad Brother Bowker brought up this subject of corn and nitrogen. I have been quite an extensive grower of corn, as most of you know, and I have tested this nitrogen question very nearly to the limit. I know something about corn, and I can tell the difference between an ear of sweet corn and an ear of common ensilage corn, which I understand some members of the Board cannot. I have tested the growing of corn with excessive quantities of nitrogen, with no appreciable effect whatever. Corn doesn't seem to be hurried along like other crops with an excess of nitrogen ; it doesn't seem to boost it along. The corn waits the natural action of the climate and the soil to produce its crop. I have put on as much as 200 pounds to the acre, right on a corn crop, and it didn't make any difference ; for corn that had only 100 pounds or 75 pounds to the acre was as large at harvest time as that which had 200 pounds. Any one who is using an excess of nitrogen in growing corn is throwing that much money away. I believe the proper thing to do is to carry out Professor Brooks's idea in growing corn, — grow it where it will grow naturally, and not try to grow it up above the tops of the clouds. Grow your potatoes up where the silver lining is, but grow your corn down where you can see the black spots.

Evening Session.

At 8 o'clock in the evening a reception and banquet was extended by the Springfield Board of Trade. The affair was held at Cooley Hotel, and covers were laid for about one hundred persons. In the absence of Governor Guild, who was unavoidably detained, owing to the illness of Mrs. Guild, Lieutenant-Governor Draper was the guest of honor. Prior to the banquet a reception was held by him in the corridor. Ex-Mayor W. W. McClench acted as toast master. After dinner speeches were made by Lieutenant-Governor Draper, First Vice-President Sessions of the Board, President Butterfield of the Massachusetts Agricultural College, Editor Herbert Myrick of the "New England Homestead," Secretary Ellsworth of the Board, and Mr. F. E. Dawley, New York State director of farmers' institutes. With a few brief remarks by the toast master, the banquet was brought to a close at 10.30 o'clock.

THIRD DAY.

The meeting was called to order at 10 A.M. by Secretary Ellsworth, who introduced Mr. Wm. A. Bailey of Northampton as the presiding officer.

The CHAIR. I regret that some have been obliged to take an early train home, on account of the bad weather; but those of you who are here are interested in the subject of the morning lecture, I am sure, and we shall have just as much discussion as if there was a larger number present.

It seems to me the lecturer has a very interesting subject to the people who live in this part of the State, the Connecticut valley. There is a lot of tobacco raised here, and a lot of tobacco made. But you do not want to hear me talk, so I take pleasure in introducing to you Dr. E. H. Jenkins, director of the Connecticut Agricultural Experiment Station, who will speak to you on the "Requirements of the tobacco trade, and how can the grower meet them?"

REQUIREMENTS OF THE TOBACCO TRADE, AND HOW CAN THE GROWER MEET THEM?

BY DR. E. H. JENKINS, NEW HAVEN, CONN.

We consider, of course, only the trade in cigar wrapper leaf. As that is the only kind of tobacco which the New England States at present produce at a profit, no other branch of tobacco growing concerns or interests us much as growers.

There is a general feeling just now that, as regards this industry, the times are out of joint. Things are going on which we do not fully understand. Trash tobacco, which the grower who sorted his own crop had often in former times thrown into his pig pen as worthless, sold readily last fall at 5 cents and from that up to 8 and even 10 cents a pound. At the same time, light wrappers — of poor quality, to be sure — were dead, and could not be sold at any living price.

The crop of 1906 is moving into dealers' hands at fair prices, but it is generally regarded as a crop of superior excellence, which ought, under ordinary conditions, to bring higher prices than it does. Sumatra leaf has for years been a thorn in our flesh, and it wraps more than one-third of all the cigars made in the United States, in spite of an import duty of $1.85 per pound.

But now, if reports are not exaggerated, our business enemies are of our own household. Florida and southern Georgia are again becoming a great tobacco-growing region, and, while at present its output wraps only about one-tenth of the cigars of this country, the business, because of its apparent success, is likely to grow to an extent which we cannot foresee. At present Florida has the call on the market, and its crop sells itself. Florida and Sumatra are unquestionably the popular tobaccos with manufacturers. Wisconsin leaf is more largely used for wrappers than it was, and New England wrapper leaf is losing its preëminence. While formerly our tobacco commanded the highest price in the domestic markets, it is now in the second place.

Now, we are all familiar with the whims of manufacturers and smokers. Many of us remember the whim for dark wrappers, when Pennsylvania wrappers commanded a better price than Connecticut, just because of their dark color. Some of us resweated our leaf, to darken it, so that it could find a market; and manufacturers are said to have stained their wrappers, or the cigars made from them, to suit the smoker's fancy.

We have seen the pendulum swing the other way, and heard an equally irrational call by the trade for extra light goods.

We have lived through a short-lived craze for spotted cigars, when not only the tobacco leaf but the grower and his family and his horse and his dog and everything that was his neighbor's was spotted and made sore with caustic soda. But the patentee of this painful process has gone, and only the tools of the art are left for the museum.

Now, what does this present call for Sumatra and Florida leaf, to the neglect of our New England wrappers, really mean? Is it a fad or fancy, which will pass like the demand for light or dark or spotted leaf? Is it that wrappers from the places named have a smoothness or finish which the smoker just at present demands, and which Connecticut leaf lacks? If it is something of this sort, we may go on our way and say: "Let the heathen rage, and the people imagine a vain thing. Before a great while they will come back from these strange gods, and ask for the same old reliable goods that New England has been passing out to them this many years."

But if, on the other hand, this demand for Florida and Sumatra leaf is something other than a fad, if it marks a change in manufacturing or market conditions which is likely to be permanent, then it is time for us to sit up and take notice; to ask what we can do to meet this changed condition, or whether we must become a binder rather than a wrapper-growing district.

The cigar is not any more a luxury of the rich or the well-to-do. The consumption in this country of over 7,000,000,000 cigars a year is increasing at the rate of 175,000,000 annually; therefore, the great struggle is to make them as cheaply as possible. The production of good grades of Havana filler has not at all kept pace with the increased cigar manufacture; and, as all of us who smoke know to our cost, the quality of cigars has greatly deteriorated.

The manufacturer, in fierce competition with his business rivals, requires a wrapper leaf which shall have these qualities: —

1. It must be so well sorted that all the leaves in a case or bale are alike in all respects. *Colors* must be uniform, so that the work of grading when the cigars are boxed will be very light. *Size* and *shape* of leaf must be perfectly uniform so that the manufacturer may see at a glance from his sample just how many wrappers he can cut from the package, and, what is equally important, so that he may avoid the expense of a sorting and rehandling at the factory.

2. The leaf must be "profitable," *i.e.*, it must cut with little waste; otherwise, besides making cigars, he becomes also a dealer in binders or in considerable quantities of cuttings, which is aside from his main work.

3. He must be able to buy an amount of wrapper leaf sufficient for his needs for the year, of one size, shape, soundness and general quality; otherwise, the brands which he makes will not be uniform, but will one month be one thing and the next month something a little different, all of which works against stability of trade.

4. The wrapper must have "style," smooth finish and small vein, to please the eye of the smoker.

Besides all these things, of course, the leaf must burn fairly, and it must have no pronounced evil taste.

Mind you, I have not stated the characters which go to make up a cigar which, in the opinion of a smoker of good taste, is a good one; I am discussing only present trade conditions, — the things which the trade demands, which are necessary to the life of a cigar-making trade that must turn out things called cigars at the lowest possible cost of manufacture, or must perish.

Every district has some small factory, whose owner, old in the business, has a small select trade which stands by him; he is a good judge of wrapper and filler, and he makes a fair living by making good sound cigars. He knows that a well-grown and well-sweated Broad-leaf wrapper and binder with a good Vuelta filler is the best thing possible to smoke; and his patrons know it, and buy his rough-looking, homely cigars in preference to the sleek-looking things with giddy paper bands about them which are too often full of all uncleanness. This cigar maker will roll up about 20,000 cigars from a case of Broad-leaf, 375 pounds; that is, he uses about 18 pounds to 1,000 cigars, gets his binders out of it, and sells a lot of cuttings for from 10 to 20 cents per pound. He sorts the case himself, to pick his wrappers and binders; he resweats the case linings; and he must spend some time in handling and sorting the cigars to make the colors even in each box. From such a man and such a factory some of us like to buy.

But such men as these do not make the "cigar trade," any more than old-fashioned, careful shoemakers, who regard the individual shape of your foot, and take pride in their workmanship, constitute the shoe trade. Such cigar makers as I have described cut no figure at all in the demand for wrapper leaf. The men whose demands the grower must meet are owners of large factories, who make cigars by the tens of millions, — cigars which are good-looking and cheap, which will burn and will not smell or taste too badly in a saloon, a smoking car or in the open air; and to these men and these aggregations of capital all business is tending.

Now, this is a Fast-day rather than a Thanksgiving-day discourse, and mine is the unwelcome task of asking you to consider the faults of our tobacco, and not its excellencies.

First, then, as it leaves the dealers' hands it is not nearly as uniform in colors, shape or even in size as either Florida or Sumatra leaf. It is sorted before sweating, and never afterward. Colors change unequally in the sweat. The leaf next to the sides of the case does not sweat in the same degree as that further in, so that cigar manufacturers often must resweat this outside leaf, — a thing which adds to the cost. The tobacco is, to be sure, sized according to length; but any one who studies his crop carefully in the field knows that even in his own crop the width and shape and style of leaf vary a good deal, even when the length is the same; and comparison of the crops of different growers emphasizes these differences. Where several small crops must go to make a packing, no care on the part of the packer can avoid this lack of uniformity in shape and size of leaf.

With Sumatra and also with Florida leaf the case is quite different. In the first place, these tobaccos are sorted *after* sweating, not before. The colors are fixed then, and as they are when they leave the sorting table, so they are when they reach the cigar maker's table. For the same reason, there is no resweating to be done; all of each leaf from tip to butt and all the leaves are evenly sweated. Here is a saving of labor, and so of expense to the manufacturer. There is no resweating, and very much less of picking and choosing of colors to be done in sorting for boxing the cigars.

Then, as to sizes and shapes of leaf. The Florida, and of course the Sumatra leaf, is very much smaller than our northern-grown wrappers; and, while each may be equally well sorted as to length, the inequalities of width and of general shape are very much less in the former than in ours. This evenness of shape greatly lessens the labor and skill needed in manufacture, and so lessens cost of production.

In the third place, on account of its small size the Florida leaf is, in the language of the cigar maker, "more profitable," — that is, it cuts to little waste. Take out the four wrappers from a Sumatra type of leaf, and there is little left but the stem and a few rags of leaf. On the other hand, cut four wrappers from a big Havana or Seed-leaf, and you have left perhaps two inferior wrappers, or a few binders and a large amount of waste leaf for which you paid 50 to 70 cents a pound, to use as filler if you will, or to sell again for from 10 to 20 cents a pound. You have, in other words, a lot of waste product on hand, to dispose of as best you can. This is bad enough, and it is made worse by the fact that, owing to the varying shapes of the leaf, you cannot accurately tell beforehand just how large this waste product will be ; it is a risk in buying. Of course certain leaves, certain whole cases, may be used as "vein-cutters" for molded, not for hand-made cigars.

And, lastly, the Sumatra and Florida leaf is raised chiefly on very large plantations, under quite uniform conditions of soil, tillage, fertilizer, etc., and with one particular strain of seed. Large packings can be made of leaf which is all one thing. With us, several distinct strains of both Seed-leaf and Havana are grown ; our plantations are many, and relatively very small ; no two of us have the same ideas or practice regarding fertilizers ; and the character of the tobacco soils differs as radically as the moral character of the growers or their ideas of the methods of fertilizing and handling the crop. As a result, the packer has a large number of cases and samples of any one grade, — 22-inch light wrappers, let us say, — which are not alike in style, in shape or in yield of wrappers. From them a small manufacturer can pick here and there goods that are alike and in quantity sufficient for his need ; not so the "trade,"— the big factory which is turning out millions of cigars each year.

The buyer cannot readily find in this collection enough cases of goods running alike in these particulars which I have named ; and he turns to the Florida leaf because, with vastly less trouble and expense, he can get just what his factory needs.

And, lastly, the smoothness and finish of the Florida and Sumatra leaf at their best have some attraction to buyers which may be more than a passing fad. Certainly the best wrappers as to smoking quality — Cuban and Broad-leaf — are by comparison rough in texture and often dull in color.

Now, the difference between our Havana and Broad-leaf on the one hand and the Sumatra and Florida types on the other is often put in this way : —

Two and one-half pounds of Florida or Sumatra leaf will wrap 1,000 cigars ; it takes from 8½ pounds upwards of

New-England-grown Havana or Seed-leaf to do the same; therefore, Florida leaf at $2 is as cheap as New England leaf at 50 cents.

I believe the present demand for other wrappers than ours is not to be explained solely in this way, but that the other things which I have mentioned have much to do with the present demand for tobacco of the Sumatra type and the apparent neglect of our domestic types.

Will these demands of the trade continue indefinitely, or are they only a passing phase?

No one of us is a prophet. No trade situation is permanent. New tobacco-growing regions may develop, or a demand for fine quality in cigars rather than for great numbers may change the situation. The free-trader may let in Sumatra like a flood. But at present the signs of the times distinctly point to the concentration of the cigar-manufacturing business in a comparatively few great concerns, a demand for cheap tobacco, *i.e.*, for leaf which will make good-looking cigars with little waste, and a demand for large packings which are perfectly uniform in all respects. A great manufacturing establishment is demoralized by variations in quality of raw material much more than the small individual manufacturer.

It would seem, then, that our New England tobacco industry is likely to change, and to go in one of three directions: —

Either it will produce a leaf of superior excellence for wrapping the best Cuban filler, to meet the demands of a somewhat select cigar trade; or it will become, as Wisconsin has largely become, a grower of binders, bringing much lower prices than we get at present; or, lastly, it will more nearly meet the present requirements of the cigar trade, and thus maintain itself against all comers.

This, you will say, — and I admit, — is prophecy, and prophecy is uncertain. I am venturing only a personal opinion, not unsupported, I believe, by the judgment of some who have a better chance than I to know the course of the tobacco trade. Whether I am right or not in my prophecy, I feel quite certain that I am right in my statement of certain grave defects in our domestic leaf as it is at present; and, whatever the future has in store, to remedy present defects is sound business policy.

Let us then briefly consider what we can do towards improving our leaf to fit it better for present competition with other tobaccos. Let us set these defects, this indictment of New England tobacco, once more before us in order: —

1. Being sorted before sweating, the colors of the finished leaf are not even and uniform.

2. The sweat is not even all through the case; the leaf next the case is less perfectly sweated than the middle.

3. The sorted leaves, while of one length, differ both in width and shape.

4. The leaf is too large, and in consequence "unprofitable" to the cigar maker. It cuts so as to leave much waste, — binder, cuttings and trash.

5. The strains of tobacco grown are numerous; the plantations are small; soil, fertilizers and handling vary a good deal, — all of which makes the small packings differ too much in quality.

What can we do about it all?

Two of these items concern the packer alone, being defects in the method of sweating the leaf.

Some packers have tried the bulk method of fermentation with indifferent success, and some have concluded that it is inapplicable to our New England leaf. It is more expensive than casing, and the bulk-sweat goods, when cased to age, as I believe is necessary for any tobacco, look, when sampled, like recased goods, and excite the suspicion of the buyer and call for explanation.

It is claimed also, I believe, that bulk-sweat domestic leaf sometimes retains the strong, plug tobacco smell of the bulk, even after aging. I have not heard it claimed, however, that this smell persists in the cigars, or that the actual value of the leaf for wrapping is any less when bulk-sweated.

If it is not, then the rest is prejudice which might be overcome in time, in view of three apparent advantages of the method, namely: The leaf can be sorted after it is finished, when the colors and quality are fixed. This, to be sure, is much more difficult, because the finished leaf goes out of case and becomes chippy much more quickly than the unfermented leaf. But if the advantage of sorting the finished leaf is great, it will not be impossible to make the climate of the sorting room moist and warm enough for the purpose. Secondly, damage in the case is avoided. Thirdly, every leaf and all parts of the leaf are evenly fermented.

Mustiness and canker generally attack cased tobacco before fermentation begins, when it is lying cold and damp, waiting for the turning of the seasons to supply the heat needed to start the fermentation. It is possible that much might be gained by starting the fermentation at once in the cases of unsorted leaf with very mild artificial heat, and when active fermentation has ceased, and while the leaf is still damp, sorting and repacking it, to mull and finish through the summer.

All this, however, is the packer's business, and experimenting on fermentation is hazardous, and likely to be very expensive because of the large amount of stock which must be used to test the process satisfactorily.

The other three defects of our leaf, — and by "defects" I mean only partial failure to meet what the present trade wants, — the other three defects concern the grower alone.

Can we do anything to remedy them? Can we grow a much smaller leaf, more uniform in size and shape, and can we make the crops of our many small farms more uniform in all their qualities?

Considering the question of size of leaf, it is no real objection to say that a smaller-leaved type of tobacco will greatly lessen our yield per acre. We all know that a small good egg is more palatable for breakfast than a large bad one, and we are willing to pay more for it.

The average yield per acre of the Florida shade-grown is, I understand, about 4 bales of 150 pounds, — a total of 600 pounds of merchantable wrapper leaf; but this at 75 cents a pound pays the grower as much as 1,800 pounds of our leaf at 25 cents. The shade-grown Sumatra leaf now raised in Connecticut yields from 1,000 to 1,200 pounds per acre. The point I make is, that yield in pounds per acre is not worth considering. Cash return to the grower is the vital point.

At present there is not a small type of leaf grown in the open in New England perfectly suited to the trade, and which can compete on equal terms with the Sumatra type in the American market. Some types are better suited than others, but none are perfectly satisfactory. All of it is too large. Our Havana and Broad-leaf, as usually grown, tend with each new crop of seed to grow larger.

The tobacco-breeding work which has been done in Connecticut in the last three or four years by the United States Bureau of Plant Industry, in connection with the Connecticut Agricultural Experiment Station, has, I think, established certain facts which are of great value in our effort to get and keep more desirable strains of tobacco.

It has been shown that the tobacco plant is perfectly self-fertile, and continues so for at least four years; that is, the flowers, to produce seed, do not need to be cross-fertilized by insects or any other means.

Again, it has been shown that, if protected from such crossing of pollen, a fixed type of tobacco will reproduce itself from seed without any marked variation, — at least, with much less variation than plants not so protected, thus securing greater uniformity in the field than we have at present; while, on the other hand, indiscriminate cross-fertilization tends in the opposite direction, namely, to induce or to intensify individual variation, which means uneven tobacco in the field and in the pole-cured crop.

A method of preventing cross-fertilization has been practiced in our experiments which is entirely effective, and yet permits the maturing of the self-fertilized seed.

Thirdly, it is possible, by artificially crossing very distinct types of tobacco, like Broad-leaf and Cuban, Connecticut Havana and Sumatra, to produce hybrids having shape and size superior to the domestic varieties. Such hybrids, like all others, have a tendency to "break up," that is, to yield plants differing among themselves much more than those of the original types from which the cross was made. How many years are required to fix this hybrid type is not yet determined. Certainly four years are needed, at the least, so that improvement by hybridizing is a slow process.

Fourthly, starting from the Sumatra crops which were grown under shade with seed from Florida, and which all who saw them knew were a hodge-podge of many different strains of Sumatra, as well as other types, there has been selected a single type of Sumatra, yielding twenty or more wrapper leaves per plant, which, as far as shape and size go, perfectly meet the present trade demands. This selection, known as the "Uncle Sam Sumatra," has, I am told, been introduced into Florida, and has this year given perfect satisfaction.

The experience we have had thus far in our breeding indicates that, by very carefully selecting individual plants which in size, number of leaves, as well as in size and shape of leaf, are particularly choice, by protecting their flowers from foreign pollen and by using their seed alone, it is possible for any farmer or any community to produce in a few years crops with decidedly better leaf, as far as shape, size and uniformity go, than we now have. The present method of getting seed is irrational. It is not the best individual plants that are selected, but a bunch of good-looking plants in one spot, which will be out of the way of the teams at cutting time. They are not protected from the pollen of any tobacco plants growing within a mile, and, in consequence, their seed yields plants less uniform than they should be. This method is not only irrational, it is becoming antiquated.

The advanced methods of the plant breeder are doing much for other crops, — wheat, oats, corn, sugar beets, onions. No crop needs them more than tobacco.

I believe that if these methods were rigidly and generally followed for five years we should find much less variation in shape and size of leaf in our fields, and the different strains of tobacco which are specially popular in one place or the other would show much more distinctly than they do now, because each farmer would select plants which showed the strain characters which he favored, and these would be kept from mixing with others. So much for the improvement in size and shape of leaf of the varieties we now have. This work we ought to do in any case, and it is work to be done by the grower himself.

It is not certain, however, that the varieties we now have and have raised for so many years are fitted to survive in the present struggle, however much we may change and improve them. It may be that we shall have to be content with growing binders, unless we can successfully grow leaf of the Sumatra or the Cuban type either in the open or under shade.

Just what is the source of our Havana and Broad-leaf varieties we do not know. Tradition says that the Havana is acclimated Cuban.

The Bureau of Plant Industry and the station have Cuban selections three generations from the island, that is, it has been grown in each of three years from seed of the previous year. It is not yet fit to try as a crop, because the leaf is obviously of no such size, shape or quality as to warrant a field test. It is, however, gradually changing its character, and we are watching to see whether in this way we are likely to get what we want.

It is also conceivable, at least, that a tobacco having the Sumatra shape and size of leaf may be developed which will grow in the open and will have something of the body, grain and other desirable qualities of the domestic leaf. Such a find would, of course, be the best way out of all our troubles.

Give us the size and shape required by trade, and the other qualities which our leaf now has, and we are secure.

These are ways, you see, in which the United States government and the station can co-operate and supplement the work of the farmer. Do not jeer at us if our work makes slow progress, and if, after all, the results are negative. I have often heard dealers say, "Your leaf is too large. If you would start anew with seed from Cuba and grow it a few years you would have a vastly better leaf than you now have." Easily said, very likely untrue, plausible any way, — the statement will always remain an unlaid ghost unless we put it to the test, and see whether the ghost is a valuable citizen or the unsubstantial vision of a dream.

It is worth everything to know the truth. It is worth a good deal to explode untruth.

Now, I have no judgment at present about this adaptation of Cuban tobacco in New England. My point is, that we hope to determine the truth about it, and this is worth while, whether acclimated Cuban leaf proves to be valuable to us or not.

And, lastly, I wish to utter what I fear will cause laughter, or be regarded as heresy. I believe that the fiasco in New England shade-grown Sumatra of a few years ago proved nothing except the futility of introducing a new method of growing tobacco by the beating of tom-toms and the plunging of the get-rich-quick people.

When I was a boy, and went bathing with the crowd, if we found a new hole, the wise boys went in and sounded it all around, trod water and hunted for any snags, tree trunks or rocks; but there were always a few youthful Boanerges who dived in head first with a whoop. Sometimes they came out all right, but sometimes they came out with sore heads, and said it was no good. They were good fellows, too, but they were candidates for court-plaster and bandages, just the same.

Regarding the growing of Sumatra under shade, I see no reason to amend what I said in my printed reports of 1900 and 1901. In 1900 I said: —

> It remains to be seen whether such tobacco [shade-grown Sumatra] can be *economically* raised in Connecticut, — raised on a considerable scale, *at a profit*. To determine these points will probably require some years of experiment.
>
> We would strongly urge farmers not to undertake to raise Sumatra tobacco under shade at present, in anything more than a very small way, and purely as an experiment, which will not seriously cripple them, even if it is a complete failure.

And again, in 1901 I said: —

> In conclusion, our success with two crops, the first raised during a season so dry as to affect the growth of tobacco in the open, the second raised when the latter part of the season was unusually cloudy and wet, indicates that Sumatra tobacco can be successfully produced in Connecticut under shade in any season which is not very abnormal as to rainfall and sunshine.

It is, however, a new industry which must be slowly learned by our growers. While much may be acquired from the prevailing ideas and practices in Sumatra and in Florida, there yet remains much more which is absolutely necessary to success, but which our growers must learn for and by themselves.

The adaptation of methods of raising, harvesting and curing the leaf to the special local conditions of labor, and particularly to the peculiarities of our climate during growth, harvest and curing, are essentials to be worked out by our growers, and in which no one but themselves can be experts.

We are not raising Sumatra tobacco, or Florida tobacco; we are not in a Sumatra climate, or a Florida climate. To succeed, our farm practice must be that which we find best for this leaf under Connecticut conditions.

At present there is much more in our favor in experimenting again with shade-growing than when we began.

First, it is unpopular. The experimenter will be let alone, which is what he needs.

Second, we know a good deal more about handling the crop and about the loss which comes from handling it too much. We have some of the appliances which we used before, and a good deal of experience; therefore, it is not an absolutely new thing to us.

Third, and most important of all, I think, largely through the careful selections which Mr. Shamel has made, we have seed which we have proved by three years' test will give us plants bearing over twenty-one leaves apiece, which are very uniform in shape and size throughout the field, and which, in these particulars, are very nearly like the imported Sumatra.

We had nothing of the sort when we made our experiments in 1900 and the following years, and this fact alone had a great deal to do with the general lack of success. The yield of pole-cured leaf was much smaller than it would have been with this improved seed which I have described; and, because the plants were of ten or twelve different types, instead of one, the expense of sorting and the damage and waste wrought by sorting were vastly more than they should have been.

Certain growers have raised small areas of shade-grown every year since 1901, chiefly, to be sure, of Broad-leaf or a hybrid, which indicates that they have not made a flat failure financially, and that they are not hopeless of the outlook for the method.

Now, this is no plea for the revival of shade-growing tobacco. I do not advise any one to go into it as other than an experiment. But I do feel that it has possibilities of success in it, and that it may yet be a partial solution, at least, of our present difficulties.

I have not left myself time to fairly discuss ways of meeting the last difficulties, viz., the lack of uniformity of leaf which comes from small plantations, inequalities of soil, differences in strains of leaf-grown and in methods of fertilization, tillage and handling.

These are, in a measure, unavoidable. Tobacco cannot be grown here in large areas of uniform soil, for we have few such areas. The average area under a single management probably does not exceed 8 acres, whereas it is vastly larger in Florida and Sumatra. Our growers have a considerable number of strains, differing slightly in character, which they hold on to; and each is willing that all should adopt his strain of tobacco, but is not prepared to admit that any other is as good. There are certainly four or five different strains of Broad-leaf and several of Havana. It is worth considering whether it might not be for the general advantage if these were abandoned for the sake of more uniform production.

I believe in the last ten years we have got together more in the matter of fertilizers than before, and that differences of quality from this source are less than they were. I believe our main defects at present in this regard are the use of too little lime and perhaps a wasteful excess of potash and deficiency of humus in the soil. Certainly dealers and manufacturers assert that one great defect in Connecticut leaf is the variations in burning quality and in taste, — variations caused by differences in soil and fertilization, which are much greater than in Wisconsin tobacco.

This is the somewhat sombre view of the situation which I feel that some friend of New England tobacco growing ought to present. It is, as I have said, a fast-day sermon.

It is not, however, the swan song of a decadent industry which is doomed.

The situation which I have indicated will not come on us suddenly, — it may not come at all. We may adopt the happy-go-lucky philosophy of the New York street arab: "Keep cool; it won't last; nothin' does."

There will probably always be a demand for good, sound Connecticut leaf for cigar wrappers at some living price, but we shall never again have a practical monopoly of high-priced wrapper leaf.

To sum up what I have tried to make clear in this talk: —

New trade conditions make demands as to cigar wrappers which our product does not at present meet.

Its defects are: —

First, the leaf is not as uniform as it should be in any respect. Particularly is this true of its shape, size, colors and burn.

Second, it is less profitable than that of our chief competitors, in that it is too large to cut to the best advantage, and the cases are not evenly fermented, the linings often needing to be resweat.

Third, the packings of individual growers are too small and too unlike to make it easy to secure large quantities of uniform wrappers from them.

We need to do all we can to overcome these defects: —

First, by careful selection and breeding of our seed towards uniformity of size and shape of leaf.

Second, by greater care in the use of fertilizers, and, as far as possible, uniformity in our tobacco formulas.

Third, by improvement, if possible, in the sorting, sweating and casing of the leaf, on the part of dealers.

Fourth, by co-operation with the agricultural stations and the United States Department of Agriculture in the thorough testing of types of wrapper leaf different from what we now use.

And, lastly, we need to remember that tobacco growing is not to be exempt from the fierce competition which besets all modern business; and that the successful man is the one who furnishes what the trade wants, rather than what he knows the trade *ought* to want.

Mr. A. M. LYMAN (of Montague). My father years ago grew some tobacco on new land, and he said it was remarkably good tobacco. We have experimented somewhat along that line, beginning three years ago, and the quality of tobacco we got was very good, and it did not need nearly as much fertilizer as on the old lands. What can we put on our old land to make such a leaf and quality as we get on this new land? By new land I mean where we cut off timber, woodland, with stumps. Around the stumps it was not as nice, but a little further up in where the good rows were was some of the finest tobacco I have ever seen grown in our valley.

Dr. JENKINS. In what single respect was it better than the other tobacco, or was it simply of better quality all through?

Mr. LYMAN. In every way, sir; the leaf was a trifle heavier, but the extra heft was of the same quality, and as fine and nice a leaf as anything we had, and those who looked at it remarked it right off. We could see by what they said that it was pleasing to the buyers.

Dr. JENKINS. That is an interesting experience, and is in line with a sort of theory I have had, although down in Connecticut they say tobacco improves the longer you grow it; a lot forty years old raises better tobacco than at first. We started our five-year experiments with fertilizers on poor new land, covered with poverty grass, wild blackberry bushes and so forth, and the quality of our tobacco was better after the land had been cultivated two years. That is rather a different proposition from what Mr. Lyman suggests. In Sumatra they can't raise tobacco more than two years on the same land; then they let it go back to jungle growth for six or seven years before raising tobacco on it again. In that semi-tropical climate land goes back to wild growth very quickly. They say they lose quality after tobacco has grown more than two years on the same land. Mr. Lyman planted where there had been woodland, and there you have a soil in which there is a lot of humus, a lot of vegetable matter; and I believe one thing to look out for in our tobacco soils is this supply of humus. We lime them and put on chemical fertilizers, and many of our tobacco soils are simply yellow sands, what a corn-growing farmer would call lifeless. There is no vegetable matter or humus in them, and they suffer more from drought. I suppose you have two sides on the fertilizer question, — advocates of both stable manure and fertilizers; I believe both are right, and I think you have to use both; but rotation of crops to give some supply of vegetable matter to the soil, I believe, is very important. It makes the soil soft, and better suited to the growth of any crop. If we felt that we could afford to do it, I believe we could get better results with tobacco if we practice some kind of a rotation; growing grass at least one year in three or four (although tobacco soil is very poor grass land), or clover, — something of the sort, to give the land a rest and to get another crop on it. I think that would be to the general advantage. I believe our growers say they cannot afford to practice rotation; that they have to keep in tobacco, as all their equipment is suited to that and nothing else, and they get more for tobacco than they can get for any other crop. I saw two or three places in Connecticut this year where the root rot had caused great damage on a part of the field, but on another part which had been in corn for two years before the tobacco wasn't in the slightest degree affected by it. It is a tradition that you get poor tobacco after corn; but this man got an excellent crop after it, and had no trouble with the root disease. I believe a certain amount of rotation would be of great advantage to us, if we could afford it. At any rate, I think, either by cover crops, or catch crops, or manure, we should get more vegetable matter into our tobacco soils.

Mr. THOMAS GERRY (of Hadley). Will you tell us why we cannot get as good a burn as some other people?

Dr. JENKINS. There isn't any better burn than the best burn we get in the Connecticut valley. Our best crops have a perfect burn, but there are crops that have an inferior burn, not a perfect burn, and the manufacturers say it is the way it has been fertilized. That is what the dealers say. I think it is partly that, and partly, perhaps, due to the varying quality of the land, which may not naturally produce a good burn. In Wisconsin, I understand, whose soil has a great deal more lime than ours, they use very little fertilizer, using some farm manure, and the course of treatment of the different farms is much more uniform than in Connecticut, because there is so little fertilizer used that the difference is much less; that seems to be why it is of a more uniform burn. I don't mean to say it is better than ours can be, but it is a perfectly uniform burn all through, and it is a good burn. It isn't any better than our best burn; it is better than our poorer burns, and it is all one thing, — it is uniform. They are getting higher prices now, I was told the other day by a man interested in growing tobacco in Wisconsin, and they think because more is being picked out for wrappers.

Mr. Cyrus M. Hubbard (of Sunderland). What do you think chickweed in tobacco land indicates? Sorrel indicates it is sour; does chickweed indicate any particular element in excess, or that is deficient?

Dr. Jenkins. As far as I can make it out, it doesn't indicate anything, except the land has got seeded with it in some way, — I don't know how. Our growers say most of it is where we have used cotton-seed meal, but I don't think chickweed is ever in cotton-seed meal; but it is a thing that blossoms all the year round, and seeds in the winter, and if it ever gets in, it seeds indefinitely. It does not indicate any fault in the land; it simply has got in there in some way, and is a very persistent breeder. It does no harm; if I didn't have any better cover-crop in winter, I would rather have chickweed than nothing. It is not an acid-loving plant, like the sorrel; the juices of the plant itself are not acid, and I should consider it a harmless thing. It goes out on cultivation, and it does not hurt the crop in the season. Has any one here tried Russian vetch as a winter cover-crop? We have tried it somewhat in Connecticut, and rather like it.

Prof. Wm. P. Brooks (of Amherst). I have no experience with tobacco, but we have tried Russian vetch in Amherst, in orchards for the most part, and we like it. It seems in many ways the most satisfactory cover-crop. I don't feel certain whether it would be entirely satisfactory if sowed after tobacco is removed; it does best if got in sometime in July; it takes a little time to get hold, get rooted, and unless pretty well rooted, isn't certain of going through the winter. A little bit of experience may be of interest as to chickweed. The best farmer, I think, taking everything into consideration, that I have ever met, is a gentleman in Concord, Mass., who raises a great deal of asparagus, and my ideas in thorough farming were a good deal shocked in going out with him and seeing his asparagus fields covered with the densest mass of chickweed, — I presume quite a number of tons per acre. I made some remark about it, and he said: "I don't care anything about that; I rather like it; it furnishes humus, protects the soil in the winter and keeps the frost from going down deep, which is the important feature with asparagus, and it doesn't make any trouble next spring; I like to see it grow; the more I get of it, the better."

Mr. FORSYTHE (of Westfield). I put in some Russian vetch last year, but it was put in a little late, and some came up and some didn't. I had a fairly good stand in the fall; it was up about an inch and a half or two inches above the ground, but this spring a good deal was killed, lying on top of the ground; but I noticed after a little while it came on, and when I plowed for tobacco it was blossomed all over the lot; but I think a good many of the plants died, but more, that weren't up, came along later in the spring before I plowed.

QUESTION. When did you plow?

Mr. FORSYTHE. I plowed a short time before putting in my tobacco, — about the middle of May, I should think. Russian vetch makes a splendid feed for cows when turned out on it in April and early May.

Dr. JENKINS. Some of our farmers get it in about the middle of August, and it grows several inches high before winter, almost completely covering the ground; and winter before last, which was very severe, the vetch came through better than rye, which winter-killed considerably. Where it comes through, it makes a splendid cover-crop, because it holds the land down and rots very quickly when it is turned under in the spring. Rye you have to watch and turn under soon enough, or it gets too woody, takes too much water from the soil, and when turned under does not promptly rot; but this Russian vetch rots very quickly. The seed is very expensive now, but we hope we shall be able to raise our own vetch seed.

Professor Brooks. I will say on that point, some years ago, disliking to pay the high prices asked, $5 or $6 a bushel for seed, I thought I would see whether we couldn't produce it at Amherst; but it set very little seed, and, as you know, it continues to bloom throughout the long season and sets very inconveniently, so it would seem to cost us more to produce it than to buy it. Still, there may be soils which are lighter than the soils at the college farm, where it would not make so ragged a growth and the blooming would be of shorter duration, all would ripen together and set for seed. It is worth further experiment in that direction, I think. At the same time, I believe by concerted effort the seed could probably be imported and placed in the hands of those who would like to use it, at very much less cost. I found when in Germany a few years ago the prices there were quite reasonable, — I don't remember just what, but very much less than the prices in this country.

Mr. J. M. Burt (of Easthampton). I don't know anything about raising tobacco, but I would like to ask if you think a young man scraping along and trying to make a dollar would do well in that business. Is it a good time now to put up sheds and start in? Is it as good a time as it was twenty-five or forty years ago, right here in the valley?

Dr. Jenkins. I should say a lot depended on the man and the state of the market. If the young man loves tobacco and understands growing it, and wants to grow it, I would say go in and make a success of it. You can make a success of tobacco, you can make a success of peddling vegetables, you can make a success of being a Senator, you can make a success of anything, — if you have the root of the matter in you and are willing to buckle to it; and I should say the outlook for making a fair living in tobacco is as good now as it was perhaps forty years ago. Probably there is not going to be as large profit for an equal outlay of time, money and brains as there has been at some other times, but there isn't in any other branch. Farming isn't the only business where times are hard, and the other fellow gets the better end of the business and all the profit. It is a general complaint in all business. There are more business failures in the cities than in the country. There is heavier competition and more injustice in the business of the people in the city than in the business of farming; but we are feeling the squeeze which business men in other lines have felt before. Farming used to be regarded as a thing by itself, and men went into one of the learned professions, or business, or farming, as if farming was anything but business. But it is business, and when you go into business you must expect to meet competition, where in the long run the best man wins. I should advise a young man, if he was in the tobacco region and had a fair liking for growing it, that there was a good prospect for him. If he preferred dairying, and didn't care for tobacco I should say he was a fool to touch tobacco. Go into the thing you understand and love, and then, if you have a business head, you will make a success of it.

QUESTION. Isn't it a great deal more work now than it was forty years ago?

Dr. JENKINS. Yes; because the market before would take anything that was called tobacco, and at about one price, and handle it as if it were all alike. Its burning qualities, or its color or taste, didn't make any difference, but now the requirements are much different.

Professor BROOKS. That is almost equally true of every trade. The apples that used to be raised and sold at a profit cannot be sold at a profit now. The milk of the olden times doesn't seem to quite fill the bill. Tobacco raising isn't an exception.

Mr. A. WILSON (of Hadley). Do the different kinds of cover-crops have any particular effect on the color of the leaf? I am speaking of rye and clover, and so forth.

Dr. JENKINS. In the tobacco meetings which we have in Connecticut, some one grower always says that rye sours the land; then other growers say that they have used it for ten, twenty or thirty years, and it does not sour the land. I have never seen any effect of that kind. I have seen tobacco land ruined for the year by letting the rye stand too late on it in the spring. It pumped all the moisture from the soil, and then, when turned under, it wouldn't rot, and left the land fluffy, in unsuitable condition for setting tobacco. The beauty of the leguminous cover-crops like crimson clover or vetch is, that they don't make such a tremendous growth as rye does, and when turned under they rot very much more quickly, because they are richer in nitrogenous matter. But I have never known of any proof that they had any marked effect on the quality of the crop, either good or bad, except that they provide humus or organic matter for the soil, which, when well rotted, is, I believe, a good thing for the crop.

Mr. Granger (of Agawam). What do you think of barley or oats for a cover-crop, sown so they will come up four or five inches in the fall?

Dr. Jenkins. They have this advantage, they spread out more in the fall than rye; of course they are winter-killed, but they hold the soil down as well as the rye, and you don't have to take care of them in the spring. You sometimes get caught with your farm work, and cannot take care of the rye, and it gets ahead of you; but these things won't. I never heard of using barley in this way. You can let either of them go, and don't have to watch them in the spring; and they grow pretty late in the fall, and cover the ground and hold it down.

Mr. Gerry. If these cover-crops don't affect the leaf, what is the use of putting them on?

Dr. Jenkins. There are two or three uses. They hold them down, — the very light soils. We have tobacco soils in Connecticut which drift like snow in the winter and early spring; in a high wind you will see a tremendous cloud of dust going off from your tobacco fields. Your cover-crop holds that down. Then, whenever the ground is not frozen, your cover-crop, if it is rye, grows through the winter and is gathering up any plant food in the soil, and in the spring it has this capital, saving it for the tobacco crops. Besides, when you turn it under you are getting a certain amount of organic matter, humus, which is a good thing for the crop.

It is also possible for a leguminous crop like vetch to gather some nitrogen from the air; but I am rather skeptical as to that matter on our highly fertilized tobacco fields. I think they generally take it from the soil.

Mr. S. S. Warner (of Northampton). One principal objection that I have heard in regard to these cover-crops is, that they form a breeding place for the cut worm the following year. Do you think there is any truth in that?

Dr. Jenkins. There may be something in that. The cut worms form their pupa cases in the soil in the fall some time, and it is said late plowing kills many of them, as they are very tender in that state. If you get a cover-crop, you can't do that plowing and stirring. I think there is something in that objection to cover-crops, but who can say whether he gets more or less? We know we get all that we can take care of, and a great many more, where we plow in the fall and do everything we can to destroy them. They are as bad as they can be, very often, in certain years, and in other years they are not. I would rather put on my cover-crop and trust to killing the cut worm by poison, although I admit, if you didn't have any cover-crop and did the plowing, you would kill a good many of the worms. But you would have a good many, I think, anyway.

Mr. Burt. What would be the objection in sowing clover early, as we do the corn, right in the tobacco, before it is cut?

Dr. Jenkins. I should imagine there would be a good deal more chance of destroying during harvest by the trampling of teams and men than there is of ruining a growing cover-crop by harvesting corn. How much of a stand would you get in the fall or spring?

Mr. Burt. We get a good stand in seeding corn, although we tramp over it in using a corn harvester.

Dr. Jenkins. What time do you sow it?

Mr. Burt. In July.

Dr. Jenkins. You would have to go down every row if you sowed it with tobacco?

Mr. Burt. We sow three rows of corn.

Dr. Jenkins. I don't think you could sow it that way with tobacco at that time.

Mr. Wilson. I have sowed it. I sowed it the last of July, and it made a stand of three or four inches in the fall. A year or two ago I sent my man to plow the field, and he came back and said it was too bad,—that there was too much feed on it to plow. I think it makes a sweeter field for the tobacco. It didn't winter-kill with me.

Professor Brooks. I have seen the cut worm moths very frequently. They are very pretty moths, of a dark color. They come out during the late summer, and undoubtedly they must lay their eggs about that time. I should suppose that the injury, in allowing the sprouts to grow or in putting on a green manuring crop, would be that the cut worm moth would appreciate the fact that there was food for her young, and lay eggs there; and if the field were bare, she wouldn't lay them.

Dr. Jenkins. I don't know anything about the life history of the cut worm moth. Of course you know the cut worm isn't one particular species; there are a number of species of cut worms, and they hatch out for a considerable time through the season. I do not know when the moths lay their eggs.

Mr. Lyman. We are treating the cut worm in a very nice way, to eliminate him from the face of the earth. We have found it convenient and easily applied to mix the Paris green in fine middlings with sweetened water, taking it up in that way and throwing it down near each plant, or possibly only between the plants. We take what we can hold in our thumb and finger and throw it near the plant, and we find the cut worm is not of much damage to us. One man can cover an acre as fast as he can walk through, two rows at a time.

Dr. Jenkins. Some one announced in the papers that they killed all the cut worms by mixing a little spirits of turpentine in the water in the machine, and some of the boys tried it, but the plants that got water were all right, and the plants that got spirits of turpentine were killed, and weren't of any use whatever. Water and spirits of turpentine won't mix.

The Chair. I practiced for quite a good many years using nothing but wheat bran and middlings, with Paris green. I always watered the first thing in the morning after it was set, and then put on the Paris green. I proved it a good thing. One year my man went over the whole lot, but skipped part of two rows. When we came to reset, there were forty plants gone on those two rows to one on the rest. So I know it is a good thing. I think bran and Paris green just as good as any sweet you can mix with it.

Mr. Forsythe. I have tried several different things. We call this bran and molasses mixture "dope." I have tried everything, but just common bran middlings mixed with Paris green has given me the best results. I have taken something like a two-pound coffee pot with a handle, and put big holes in the bottom, as big as your finger, and with that a man will go through faster than a machine will, a good deal. Do it just after setting; and that leaves the middlings in a bunch. I prefer not to have it just on the plant, because it will sweat the plant off sometimes, but just side of the plant. It kills them, unless it rains the same night that it is put on.

Mr. Granger. I make a practice of killing them before I set my tobacco. I mix up my "dope," as he calls it, and take about 30 pounds of bran, 2 pounds of Paris green and 2 pounds of water; not have any of it dry, but have a good paste; and about sundown go over a piece and throw it broadcast, and usually it kills the worms. I make it sweet enough so as to attract them.

Mr. Wilson. Isn't there a bitter or objectionable taste to the Sumatra tobacco?

Dr. Jenkins. An awful taste to the Florida and Sumatra tobacco when not handled right. The unripe leaves are very bitter and evil tasting. But when it is perfectly ripened and has a good body it has very little bitter taste. I don't think it is as absolutely free from bitter taste as the Connecticut weed, but this is very slight where properly cured and handled.

Question. You spoke about the uniformity of fertilizers; what is your formula?

Dr. Jenkins. I haven't any. Some of us use commercial fertilizers; some of us stable manure almost entirely, and every sort of thing in between. Some use high-grade sulphate of potash, and some won't use it at all. Some use high-grade carbonate; others say it ruins the tobacco. Some growers I find use muriate of potash. Some use lime, 500 pounds a year, and others use 300 pounds once in three years. I think as a rule we use too little lime. I don't believe there is any best formula. I don't think it would be an advantage if every farmer used the same formula in the same amount for a large number of years. I think that vegetable forms of nitrogen, as a rule, have proved the best, — cotton-seed meal, castor pomace, linseed meal, if you can get it cheap enough. The report is that cotton-seed is higher than ever, and if so, it won't be any cheaper than linseed meal. Fish, — we have had good success with that. There is a decided prejudice against using any animal forms of nitrogen, like dried blood or tankage. I myself believe that some of the best forms of animal nitrogen might work very well, and, if they were cheaper than cotton-seed meal, I would try it, — not on a large tract at first. The green slaughter-house refuse, wet and tough, and containing all sorts of animal matter, which we got years ago, decayed very slowly in the soil. The stuff didn't decay quickly enough, and by the time our tobacco was ready to ripen off this green offal was just beginning to get available, and pushed the crop into growth again at harvest time, which ruined its quality. Now we are getting these things dried, and in bones quickly available, so I think perhaps the prejudice against the use of the animal forms of nitrogen is unfounded. Castor pomace is a little slower than cotton-seed meal, and I think that is one reason why it gives a darker leaf, as it doesn't become available quickly enough. The high-grade carbonate is being used a great deal by our growers, and some like it very much. Some packers say they don't like the looks of the tobacco; it is too slick; it hasn't the right finish. I haven't any formula to recommend, only I think we should get nearer together on the general character of fertilizers that we use, and I think we shall all see the necessity of using some stable manure or something of that kind to furnish humus in the soil.

Mr. Wilson. What do you think of potash from hard-wood ashes?

Dr. Jenkins. I don't know anything about them as distinguished from Canada ashes, but I should consider both excellent fertilizers. We have raised good tobacco with wood ashes alone as a source of potash.

Mr. LYMAN. A local company has made a formula which should be used in this valley to grow tobacco. I think Mr. Gerry can give that formula. It is very popular, and those who used it most got the highest price for their tobacco.

Mr. GERRY. The formula was cotton-seed meal, linseed meal, ground bone and carbonate of potash. I do not remember the proportions.

Secretary ELLSWORTH. I think a vote of thanks is due the Board of Trade of Springfield for their invitation which brought the Board of Agriculture here, and for their entertainment. They have given us the use of this hall, and have done everything to make our stay both useful and pleasant. I move a vote of thanks for the Springfield Board of Trade.

The motion was seconded and unanimously carried.

Adjourned *sine die.*

A number of those present at the closing session availed themselves of the opportunity to visit the McElwain stock farm, at Riverdale, a short way out of Springfield. The only drawback to the visit was the rainy conditions which prevailed.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT

BOSTON.

JANUARY 8 AND 9, 1907.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 8, 1907, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by First Vice-President WILLIAM R. SESSIONS.

Present: Messrs. Anderson, Appleton, Bailey, Boardman, Bradway, Bursley, Butterfield, Damon, Danforth, Albert Ellsworth, J. Lewis Ellsworth, Guild, Hersey, Jewett, Kilbourn, Leach, Mason, Nye, Paige, Pease, Peters, Porter, Pratt, Rane, Reed, Richardson, Ross, Sessions, Spooner, Stevens, Trull, Williams and Worth.

Records of special meetings of the year read and approved.

The executive committee, as committee on credentials, by Mr. Kilbourn, chairman, reported the list of qualified members of the Board for 1907. The newly constituted members are as follows: —

At large, appointed by the Governor, Warren C. Jewett of Worcester.

Elected from the —
Barnstable County Society, John Bursley of West Barnstable.
Franklin County, Frank Gerrett of Greenfield.
Hampshire, Henry E. Paige of Amherst.
Martha's Vineyard, James F. Adams of West Tisbury.
Oxford, Walter A. Lovett of Oxford.
Spencer, Noah Sagendorph of Spencer.
Union, George O. Millard of Blandford.
Worcester North-west, Albert Ellsworth of Athol.
Worcester South, C. D. Richardson of West Brookfield.

The committee recommended that the credential of the delegate elected by the Bristol County Fair, Incorporated, be referred to a special committee, to pass upon the eligibility of said society to be represented upon the Board.

Voted, That the executive committee be the special committee to take the matter in charge.

Voted, That the report of the committee on credentials be accepted and adopted.

His Excellency Governor Guild, coming in, briefly addressed the Board, but declined to take the chair.

The secretary presented and read his annual report, which was accepted.

The committee on gypsy moth, insects and birds, by Mr. Pratt, chairman, presented a written report, which was accepted.

The ornithologist to the Board, Mr. Forbush, reported progress on the special report on birds, and presented an unbound copy for inspection. He spoke of the difficulties encountered in the publishing of the book, and stated that on account of errors in estimates a deficiency appropriation would be required to meet the additional cost.

At 12.35 o'clock a recess was taken to 2 P.M.

The Board was called to order by Mr. SESSIONS at 2 P.M.

Voted, That the legislative committee be instructed to petition the Legislature for an appropriation of $1,128.80 to cover the additional cost of printing the book on birds, and for travelling and necessary expenses of the author incurred in the preparation of the book.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted.

The report of the Dairy Bureau was read by the general agent, Mr. Harwood, and was accepted and adopted.

The State Nursery Inspector, Dr. H. T. Fernald, presented and read his fifth annual report, which was accepted.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted as the report of the Board of Overseers to the Legislature.

The committee on experiments and station work, by Mr. Spooner, chairman, presented a written report, which was accepted.

The committee on forestry, roads and roadside improvements, by General Appleton, chairman, presented a verbal report, which was accepted.

The State Forester, Professor Rane, being present, was asked to speak of the work of his department, but at his request his remarks were deferred to Wednesday.

The tenth semiannual report of the chief of the Cattle Bureau was presented and read by Dr. Peters, and the report was accepted.

An abstract of the reports of inspectors of fairs, prepared by direction of the committee on agricultural societies, was read and accepted.

At 5.10 o'clock the Board adjourned to 10 A.M. Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President SESSIONS, at 10 A.M.

Present: Messrs. Adams, Allen, Appleton, Bailey, Boardman, Bradway, Butterfield, Damon, Danforth, Gerrett, Albert Ellsworth, J. Lewis Ellsworth, Jewett, Kilbourn, Lovett, Mason, Millard, Paige, Pease, Peters, Porter, Pratt, Rane, Reed, Richardson, Ross, Sessions, Spooner, Stevens, Williams and Worth.

The committee on institutes and public meetings reported verbally, the principal item being that the proposed New England conference on rural progress would be held at the office of the secretary of the State Board of Agriculture, Boston, on March 8, and that it would be a delegate conference. The report was accepted.

Election of officers being in order, the chairman declared His Excellency Curtis Guild, Jr., president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First Vice-President, Hon. WILLIAM R. SESSIONS of Springfield.

Second Vice-President, Mr. AUGUSTUS PRATT of North Middleborough.

Secretary, Mr. J. LEWIS ELLSWORTH of Worcester.

General Agent of the Dairy Bureau, Mr. PETER M. HARWOOD of Barre.

State Nursery Inspector, Dr. HENRY T. FERNALD of Amherst.

Election of specialists being in order, ballots were taken, and the elections resulted as follows: —

Chemist, Dr. C. A. GOESSMANN of Amherst.[1]
Entomologist, Prof. C. H. FERNALD of Amherst.[1]
Botanist, Dr. GEO. E. STONE of Amherst.[1]
Pomologist, Prof. F. A. WAUGH of Amherst.[1]
Veterinarian, Prof. JAMES B. PAIGE of Amherst.[1]
Engineer, WILLIAM WHEELER of Concord.
Ornithologist, EDWARD HOWE FORBUSH of Wareham.

The secretary appointed his first clerk, Mr. F. H. Fowler, librarian for the ensuing year.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

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[1] Massachusetts Agricultural College.

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, John Bursley of West Barnstable, William H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, C. D. Richardson of West Brookfield, Edmund Hersey of Hingham, Henry E. Paige of Amherst.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, O. E. Bradway of Monson, J. Harding Allen of Barre, Albert Ellsworth of Athol.

Committee on domestic animals and sanitation: Messrs. Henry E. Paige of Amherst, A. M. Stevens of Williamstown, E. P. Williams of Ashfield, Walter D. Ross of Worcester, Walter A. Lovett of Oxford.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, J. M. Danforth of Lynnfield, W. C. Jewett of Worcester, W. D. Ross of Worcester, Noah Sagendorph of Spencer.

Committee on Dairy Bureau and agricultural products; Messrs. C. D. Richardson of West Brookfield, J. M. Danforth of Lynnfield, Henry E. Paige of Amherst, S. B. Taft of Uxbridge, Geo. O. Millard of Blandford.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, W. C. Jewett of Worcester, Isaac Damon of Wayland, E. L. Boardman of Sheffield, Frank Gerrett of Greenfield.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, N. I. Bowditch of Framingham, Ralph M. Porter of Cummington, E. P. Williams of Ashfield, H. A. Oakman of Marshfield.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, H. G. Worth of Nantucket, J. J. Mason of Amesbury, Henry S. Pease of Middlefield, F. W. Rane of Boston.

Committee on institutes and public meetings: Messrs. Edmund Hersey of Hingham, Wm. R. Sessions of Springfield, Wm. A. Bailey of Northampton, Kenyon L. Butterfield of Amherst, J. F. Adams of West Tisbury.

These appointments were confirmed by vote of the Board.

The matter of changes in the law relating to nursery inspection, recommended in the report of the State Nursery

Inspector, was taken up and considered, two suggested bills being presented.

Voted, To refer the bills to the legislative committee, with power to act.

The Chair appointed the legislative committee as follows: Messrs. Pratt, Kilbourn, Spooner, Jewett, Gerrett, Bailey and Secretary Ellsworth, which appointments were confirmed by vote of the Board.

The matter of the amendment of section 6 of chapter 124 of the Revised Laws, relating to the sale or mortgage of the real estate of the incorporated agricultural societies, and to ratify and make valid transfers of real estate made in supposed conformity with the Revised Laws, was taken up and considered. Mr. Cluer, president of the Middlesex North Agricultural Society, was present, and stated the difficulties met with by said society in attempting to sell their real estate, owing to the peculiar construction of said section.

Voted, To refer the matter to the legislative committee, with power to act.

The ornithologist to the Board, Mr. Forbush, stated the need of more protection to wild ducks and teal, and suggested a proposed bill.

Voted, That the matter be placed in his hands, with power to present to the Legislature as the representative of the Board.

Mr. Forbush also spoke of the necessity of research work by the ornithologist to the Board in the matter of protection and increase of beneficial birds, and stated his belief that the work required demanded the services of a paid ornithologist.

Voted, To refer the matter to the legislative committee, with power to act.

Voted, That the secretary be authorized to ask the Legislature to increase the appropriation for the dissemination of useful information in agriculture to $4,000 annually.

The pomologist to the Board, Professor Waugh, spoke of the necessity and desirability of a greenhouse survey of the State.

Voted, To refer the matter to the legislative committee, with power to act.

The State Forester, Professor Rane, spoke of needed legislation on the subjects of forest fires, forest taxation and forest education, and presented bills embodying his ideas.

Voted, To refer the bills to the legislative committee, with power to act.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented requests by certain agricultural societies for change of date for holding their annual exhibitions, when it was

Voted, That the date for the holding of the fair of the Blackstone Valley Agricultural Society be changed to the third Tuesday after the first Monday in September; that of Martha's Vineyard to the Tuesday preceding the first Monday in September; and that of the Weymouth Agricultural and Industrial Society to the third Thursday after the first Monday in September.

Mr. Spooner, from the Massachusetts Horticultural Society, extended on behalf of that society an invitation to the Board to hold its next public winter meeting at Horticultural Hall, Boston.

Voted, To accept the invitation, and to hold the next public winter meeting in Boston, under the auspices of the Massachusetts Horticultural Society.

The Chair appointed, as a local committee of arrangements to assist the secretary and the committee on institutes and public meetings, Messrs. Spooner, Appleton, Damon and Danforth.

Mr. Pease, for the committee appointed to present resolutions on the death of Henry S. Perham, presented and read the following: —

Whereas, It has pleased Almighty God in His boundless wisdom to take from our midst one of our members, Henry S. Perham of Chelmsford, a man who, in the short period of his membership on this Board, had shown himself well fitted for the position to which he had been chosen, and had made himself highly esteemed and eminently respected by his fellow members; therefore, be it

Resolved, That we, the members of the State Board of Agriculture of the Commonwealth of Massachusetts, hereby express our sincere and heartfelt sorrow at the loss which the Board has sustained by his death; and

Resolved, That we hereby extend our sympathy to the bereaved family and friends of our esteemed associate; and

Resolved, That these resolutions be spread upon the records of the Board, and that a copy of them be engrossed and sent to his family.

Henry S. Pease.
John M. Danforth.
Geo. W. Trull.
J. Lewis Ellsworth.

Voted, To accept and adopt the resolutions as presented.

Mr. Kilbourn, for the committee on agricultural societies, reported the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 24, 25 and 26,	F. Gerrett.
Barnstable County, at Barnstable, August 27, 28 and 29,	R. M. Porter.
Blackstone Valley, at Uxbridge, September 17 and 18,	H. S. Pease.
Deerfield Valley, at Charlemont, September 12 and 13,	W. D. Ross.
Eastern Hampden, at Palmer, October 4 and 5,	A. Ellsworth.
Essex, at Peabody, September 17, 18 and 19,	N. Sagendorph.
Franklin County, at Greenfield, September 18 and 19,	J. H. Allen.
Hampshire, at Amherst, September 17,	J. F. Adams.
Hampshire, Franklin and Hampden, at Northampton, October 2 and 3,	J. M. Danforth.
Highland, at Middlefield, September 4 and 5,	J. J. Mason.
Hillside, at Cummington, September 24 and 25,	H. A. Oakman.
Hingham, at Hingham, September 24 and 25,	W. H. Spooner.

Hoosac Valley, at North Adams, September 20 and 21,	W. R. Sessions.
Housatonic, at Great Barrington, September 25 and 26,	O. E. Bradway.
Marshfield, at Marshfield, August 21, 22 and 23,	A. M. Stevens.
Martha's Vineyard, at West Tisbury, August 27, 28 and 29,	W. A. Bailey.
Massachusetts Horticultural, at Boston, September 4 and 5 and October 10 and 11,	F. H. Appleton.
Middlesex South, at Framingham, September 17 and 18,	H. E. Paige.
Nantucket, at Nantucket, August 21 and 22,	E. L. Boardman.
Oxford, at Oxford, September 5 and 6,	A. Pratt.
Plymouth County, at Bridgewater, September 11 and 12,	W. A. Lovett.
Spencer, at Spencer, September 19 and 20,	E. P. Williams.
Union, at Blandford, September 11 and 12,	H. G. Worth.
Weymouth, at South Weymouth, September 19, 20 and 21,	G. O. Millard.
Worcester, at Worcester, September 2, 3, 4 and 5,	C. D. Richardson.
Worcester East, at Clinton, September 11, 12 and 13,	John Bursley.
Worcester Northwest, at Athol, September 2 and 3,	W. A. Kilbourn.
Worcester South, at Sturbridge, September 12 and 13,	Isaac Damon.
Worcester County West, at Barre, September 26 and 27,	Q. L. Reed.

The report of the committee was accepted and adopted.

Voted, That the matter of holding a summer meeting of the Board be left to the secretary and committee on institutes and public meetings, with power to act.

Voted, That any unfinished business or new business that may arise be referred to the executive committee, with power to act.

The records of the first and second days were read and approved.

At 12.40 o'clock P.M. the meeting was dissolved.

J. LEWIS ELLSWORTH,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 8, 1907.]

Your committee find the reports of inspectors of the several fairs show no violations of the regulations in regard to objectionable attractions, and that favorable weather in almost all fairs enabled the societies to show a favorable balance.

We are still of opinion that those societies are safest which limit their attractions to those of very moderate cost, and those do best work which are most particular in the character of the exhibitions and side shows that are allowed upon their grounds, and which are prompt to remove any questionable in character that may have gained admittance under some false pretense.

Respectfully submitted,

WILLIAM A. KILBOURN.
O. E. BRADWAY.
Q. L. REED.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 8, 1907.]

It is always gratifying to be able to report progress in any direction, and in present conditions at the experiment station there are great improvements to be noticed. Having large financial means, its facilities for work steadily increase, and the new Wilder Hall built last year for the horticultural department is admirably fitted for its purpose.

There is also in process of erection a building for the botanical department, Clark Hall, to supply a long-felt want in this branch; and the need is suggested of a new greenhouse of modern construction, to control temperatures for different classes of plants.

The work of the station is already extending; it has an expert located at Falmouth, studying the cranberry disease; also one at Concord, studying the asparagus rust; and, with the large number of insect pests, this work is likely to increase.

The rust on the hollyhock is a very serious drawback to its culture; Bordeaux mixture does not check it. The disease starts at the base of the plant, following up the stem and leaves to the flower buds, destroying the beauty of this attractive garden plant. It would be a great boon to cultivators if some remedy for the difficulty were found.

The cut worm has been very annoying for the past two seasons, and its ravages call for some simple but efficacious remedy.

In view of its comprehensive aims, we have reason for pride in our station, and could fitly confer upon it the name of Massachusetts.

Respectfully submitted,

WILLIAM H. SPOONER.
R. M. PORTER.
E. P. WILLIAMS.

REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE, ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[Revised Laws, chapter 89, section 10; adopted by the Board, Jan. 8, 1907.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

The members of the committee on the Massachusetts Agricultural College made their first visit to the college in June, to award the Grinnell prizes in agriculture. The first prize, of $30, was awarded to Edwin Hobart Scott of Somerville, Mass.; the second, of $20, to Edwin Francis Gaskill of Hopedale, Mass. The contestants showed thorough knowledge of the topics assigned them.

FARM.

The farm proper consists of 280 acres, 60 acres under cultivation, the remainder in grass. Of the 60 acres in cultivated crops, most of them were corn, potatoes and onions; all of these, including hay, were exceptionally good, owing to good management and a favorable season. Most of the cattle were disposed of, owing to the loss of the barn by fire. We found some very good types of Holstein, Ayrshire and Jersey breeds; some swine; no sheep; and some very good French Coach and Percheron horses.

The horticultural department was very attractive, with its new buildings, finely equipped class rooms, orchards, vineyards, fruit, etc. In this department there seems to be need of larger and better glass houses for practical hothouse work.

The other departments were in a prosperous condition.

The agricultural department would be strengthened if better equipped.

Some of the members of this committee attended the inauguration of the new president, Kenyon L. Butterfield. Under his management we hope for a bright future for the Massachusetts Agricultural College. The large number of students, 225, shows good interest.

In closing, we will say that we hope the present Legislature will grant a sum of money ample to build the needed buildings and furnish better equipment where needed; also to stock the new barn with stock that any citizen might be proud of.

Respectfully submitted,

JOHN BURSLEY.
A. H. NYE.
E. L. BOARDMAN.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.

[Read and accepted at the Annual Meeting, Jan. 8, 1907.]

To the Massachusetts State Board of Agriculture.

Your committee on gypsy moth, insects and birds submits herewith its report for the year 1906. As in the past few years, the work of this committee has been principally confined to observing and noting the conditions in the moth-infested territory, and in giving advice to citizens seeking information as to how best to combat the moth pests. From time to time we have had occasion to examine the State work now in progress under the direction of the State Superintendent for Suppressing the Gypsy and Brown-tail Moths, and have endeavored to assist him in every way in our power. A large quantity of maps, record books and other valuable material concerning the former work of this committee has been turned over to the State superintendent, and we are informed by him that they have been of particular value in his work. He has also frequently consulted us with reference to various features of his work, and we are glad to state that most harmonious relations have prevailed between the two offices, both working for the end of preserving our fruit and shade trees from damage by one of the most injurious pests which has ever yet reached our shores.

CONDITION OF INFESTED TERRITORY.

The district occupied by the gypsy moth now extends from Tyngsborough on the northwest southward through Ayer, Marlborough and Westborough, thence easterly to Stoughton, southerly to Lakeville and easterly to Bourne. There are also several gypsy moth colonies at various points on Cape Cod. This area embraces about 2,500 square miles, — over one-quarter of the total area of the State, — and contains within its limits upward of 75 per cent of the taxable valuation of the State. The brown-tail moth is known to occur in a section which may be roughly included in a line drawn from Winchendon on the northwest to the Rhode Island border at Wrentham, and thence southerly to Westport. The latter insect is spreading rapidly throughout the State.

At the hearings before the Legislature with reference to additional appropriations for use under the direction of the State superintendent, your committee was represented by its secretary, who fully explained the desires of the committee and the Board that this work should be prosecuted vigorously, and should not be hampered for lack of funds. We have also used every possible means at our disposal to induce Congress to make liberal appropriations for suppressing the insects, and we have had much correspondence with the various Boards of Agriculture and members of Congress in the New England States and elsewhere.

The policy of the State superintendent, which has met with our hearty approval, has been to first clear the infested street trees cf the moths, in order to prevent their further scattering; and, second, to free, so far as possible, the badly infested residential districts, thus giving the largest measure of relief to the greatest number of inhabitants. As a result of this work, the streets of the infested district have been kept reasonably clear of the moths, and last year for the first time the majority of our suburban estates were protected from damage by these insects. We are obliged to note with regret, however, that the woodlands still remain very severely infested, and that this infestation seems to be on the increase. This we do not understand is due to any fault of the present State organization now engaged in suppressing the moth, but rather to lack of funds necessary to protect these lands and control the gypsy moth within their borders. It is earnestly to be hoped that suitable appropriations will be provided to stop the increasing ravages of the moth in our eastern Massachusetts woodlands.

The national Congress at its last session having provided an appropriation of $82,500 for suppressing the moths in New England States, work in Massachusetts was commenced under the direction of the United States Department of Agriculture, Bureau of Entomology, early in August. The principal features of this work, which are directed by the entomologist, Dr. L. O. Howard, with Mr. D. M. Rogers as field agent in charge, have been the thinning of protective belts in woodlands along the main highways of the district, these belts later to be cleared of eggs and thoroughly sprayed. In this way the national work will ably supplement the State work, and it has our most hearty commendation.

At the present writing, upward of 1,200 men are engaged in winter work against the moth under the direction of the State office, and over 100 men under the direction of the Bureau of Entomology.

Favored by liberal State appropriations, Superintendent Kirkland, through Dr. L. O. Howard, has been actively engaged in importing parasites and predaceous enemies of these insects, and several large colonies have been liberated in various infested woodlands. Those most familiar with this feature of the work still take a conservative attitude as to the probable benefit to be derived from these parasites.

Your committee is of the opinion that, while this experiment may prove to be a success, it may also prove to be a failure, and that no effort should be spared to control the moths through the means which we know to be effective, until the success of the parasites has been fully demonstrated.

We are informed by Superintendent Kirkland that, taking into account State, city and town appropriations, as well as the very large sums now being expended by individual citizens throughout eastern Massachusetts, the total amount expended against the gypsy and brown-tail moths in this State during 1906 will fall between $500,000 and $750,000, — a larger sum than has ever been expended under legal authority in destroying an insect pest in the history of the world. In this work the State of Massachusetts has taken high ground, and has given to the country and the world a striking example of what an enterprising and public-spirited community can and will do for the protection of its trees.

The results which have transpired in recent years fully vindicate the attitude taken by this committee, — an attitude which, although once severely criticised, is now loudly praised. Present conditions in the moth-infested district have verified every prediction made by your committee in 1900, and the great public value of the former work of this Board has now become fully established. While it is greatly to be regretted that there should have been any cessation in the work against the moths, and that this large expense in combating them is now necessary, at the same time, your committee believes that it is its duty to look forward and not backward, and to aid and assist in every proper way in a vigorous prosecution of the State and national warfare against these two serious insect pests.

Respectfully submitted,

AUGUSTUS PRATT.
JOHN M. DANFORTH.
W. C. JEWETT.
HENRY H. LEACH.
WALTER D. ROSS.
J. LEWIS ELLSWORTH.

FIFTH ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

Presented to the Board and Accepted,
January 8, 1907.

FIFTH ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to submit herewith the fifth annual report of the State Nursery Inspector.

Owing to the increasing number of nurseries, it was found necessary to begin the work of inspection this year about the first of August. As usual, a few places were inspected before this time, as their sales of stock are practically continuous throughout the year, and it is necessary that they should hold new certificates as soon after the first of July as possible.

One hundred and forty-one places were visited, held by one hundred and thirty-two owners; one hundred and fifteen certificates were given; ten nurserymen have either temporarily or permanently gone out of the business; one has thus far not met with the requirements of the law; one fumigates all stock sold; another is entitled to a certificate, but in anticipation of certain changes has requested that it be withheld for the present; and it has been impossible to visit four other nurseries without exceeding the appropriation available.

Owing to ill health, most of the actual work of inspection this year has been carried on by the deputies, and it gives the inspector much pleasure to record here the faithful work of Messrs. E. A. Back of Florence, H. M. Russell of Amherst, and C. E. Hood of Millis, who have done the work carefully and well. Some few difficult cases were attended to by the inspector in person, but any credit for the work as a whole should be given to the above-named gentlemen.

As no changes in the law were made last winter, it was found necessary, as was the case a year ago, to rule that certificates granted to Massachusetts nurseries should not be considered as covering the brown-tail moth. With one exception, no gypsy moths were found in any of the places inspected, and it would seem probable that the condition of this pest with reference to the nurseries has not materially changed since the last report.

The San José scale has been as much as ever in evidence, and the past summer has been favorable for its rapid increase and spread. The main source of nursery infestation, however, has been its introduction on certificated stock from certain other States. The inspector now has records of thirty cases where living scale was found on such stock soon after its receipt from outside the State. Of course such stock when discovered by the inspectors is at once destroyed, but most of it is bought for immediate delivery to fill orders. As a result, the scale is almost certain to be distributed to some extent in this way on trees and shrubs which have never been seen by the inspector, and which he therefore cannot be held responsible for. What may be termed an interstate courtesy exists between the inspecting officials of different States; this could hardly be otherwise under existing conditions; but it is certain that as a result of this Massachusetts each year receives quite an amount of stock which is infested. Virginia some years ago experienced conditions similar to this, and attempted to determine what stock should be admitted, and what should not, with reference to the States from which it came; but so many difficulties arose in carrying out this practice that it seems doubtful if anything of the kind would be practicable in Massachusetts. Aside from this, the control of the San José scale in Massachusetts nurseries presents few difficulties, and has in fact ceased to worry the inspector, as, if time enough to permit of thorough inspection can be taken, it is doubtful if infested trees would fail to be discovered and destroyed.

The real danger to-day to Massachusetts from this scale does not come from the nurseries, but from the orchards and ornamental shrubs outside. Though this is hardly within the province of the nursery inspector, it is a very important matter to all who are interested in horticulture in the State, and a brief outline of the present conditions is accordingly given.

The first nursery inspection under the present law was made in the fall of 1902, nearly ten years after the scale was first discovered in Massachusetts. During those ten years this pest had established itself in quite a number of different localities in the State, and since that time it has been increasing and spreading from those places. The number of agents for trees and shrubs who travel through this State is quite large, and most of these sell stock from nurseries in other States. From what has already been said as to the infestation of this stock, as shown by what is bought by Massachusetts nurseries and from what has been observed by the inspector, it is probable that each year since 1892 has seen the establishment of a number of new colonies of this scale in the State; and sufficient time has now elapsed for these colonies to have thoroughly established themselves and to spread in all directions.

The result of this is only what might be expected. It is probable that the scale is now present in nearly every town in Massachusetts, at least east of the Berkshire hills, and that, while its presence may not be known for the first three or four years after its introduction, it has in a great many places become a very serious problem. As an illustration of this, it may be stated that in 1901 one infested spot was known in the town of Amherst; to-day the inspector knows of fifteen, many of them widely separated, and in some cases at least directly traceable to stock sold by "tree peddlers."

In some places the scale can be found almost continuously on one or another of its more favored food plants over a territory of several square miles. Under such circumstances as these the presence of the San José scale in nurseries becomes comparatively unimportant, as compared with its general presence in the orchards and on the ornamental shrubs and trees around our homes. It is interesting in this connection to note that much fruit for sale in our markets shows evidence of the presence of this pest; and prizes have this fall been awarded at exhibitions in this State to specimens of fruit marked by this scale.

This is a serious condition, and one for which nursery inspection cannot be held responsible, as in most cases it has come in through channels not reached by the nursery inspector.

It has become evident that our present laws are insufficient for the protection of the people of this State from the San José scale in at least two classes of cases. One of these classes was considered in the report of the inspector last year, and I desire to call your attention to it again.

Nurserymen must keep their stock free from this pest, in order to receive certificates permitting them to make sales; but in too many cases they find this impossible without considerable expense, because of serious infestation existing just beyond the limits of their nurseries, and which they have no power to check. When the scale occurs in abundance just across the fence from the nursery, the inspectors are prepared to find the nursery stock in this neighborhood more or less infested each year, and this stock is at once removed and destroyed. The nurseryman under such conditions is practically paying an extra tax as a result of negligence on the part of his neighbors. One particular case of this kind was described in the last report, but there are many others quite similar, and at the present time the nurseryman has no means whatever of protecting himself.

The second class of cases is by far the largest. A man has orchard trees frequently in large numbers which he is willing and able to protect from the ravages of this scale, but his orchard is near others which are infested, and which are not taken care of in any way; of course the ultimate result will be that such adjoining orchards will either die out or at least become worthless, but they serve as breeding places, from which the scale each year will spread. Under such circumstances as these, any orchardist feels that spraying which he might do for the pest would be almost equivalent to pouring water into a sieve; and I have received many inquiries as to what can be done under such circumstances. One recent letter runs as follows: "It seems to me it would be difficult for me to fight the scale, if my next neighbor allows his apple trees to stand without removing or burning or spraying in any way. Is there no law in Massachusetts by which I can obtain protection?" As a result of a large number of such letters as this, and of a study of the conditions many of our nurseries are meeting, the inspector is convinced that the time has come when something must be done to give protection to those persons whose income in a measure is dependent upon the life of their orchards; and one such case recently brought to his attention may be cited as showing how important such protection is. In this case four-fifths of the entire income of a family has been received from the sale of fruit grown on the place. There are now no men of the family living, and the entire care of the estate rests upon the shoulders of two ladies, whose income has been but little more than was absolutely necessary for their support. To-day their trees are all more or less infested, and the fruit produced has begun to deteriorate in quality and quantity, thus reducing its value and their income. They could spray probably as often as would be necessary to control this scale in their own orchards, but on two sides are the orchards of neighbors whose trees are badly infested, and who are making no efforts to keep the scale in check. The consequence of this is, that spraying would have to be done every year; and, as in the locality where this orchard is help is hard to get and wages are high, it practically would take away almost all of the profit heretofore received from the fruit sold. Yet under our present laws these people have no protection whatever, and are now expecting to sell their place for any price they may be able to get.

It seems very desirable that some officer or board of the State should be given full authority to determine when an insect becomes dangerous to public welfare, and in such cases to declare it a public nuisance, to be abated in accordance with legal methods, — although this would hardly be advisable to carry into effect in all cases. Those persons, however, who feel the importance and necessity of protecting their orchards and nurseries from infestation by dangerous pests present in the immediate vicinity should be permitted to apply to some authority who would examine the conditions, hold hearings and decide whether a nuisance exists, and, if so, give directions for the abatement of this nuisance by the owner. This would necessarily need to be accompanied by a time limit for abatement, and penalty for failure to carry out the directions of this officer.

The people of this State fall very easily into two classes; those who wish to obtain the most benefit from their property, and those who are negligent. It would seem that the former class should be given an opportunity to protect themselves if necessary from those who are willing not only to neglect their own property, but to endanger that of others. The State has a rigid quarantine against cases of disease, and it might be considered a crime against human life to deliberately allow such diseases to spread; but in the case of dangerous pests, which destroy or at least render worthless our trees and shrubs, we certainly have a crime against property, which, while of course not as serious as one against life, is nevertheless one for which the State should provide some means of protection. The inspector believes that steps should be at once taken toward remodeling the nursery inspection law, so that not only nurserymen but other persons who wish to protect their trees and shrubs should have a method available by which this may be done. At present there is no such method, and a person may suffer great financial loss without being able to take any steps to protect himself.

The appropriation has this year proved insufficient to meet the expense of inspecting all the nurseries, four of which it has been found necessary to omit. Under these circumstances the time has come when an increased appropriation must be obtained, if this work is to go on in accordance with the law. An increase will therefore be requested at the coming session of the Legislature.

FINANCIAL STATEMENT.

Appropriation,		$1,000 00
Compensation of State Nursery Inspector and three deputies,	$550 00	
Travelling and necessary expenses of inspector and deputies,	437 16	
Supplies (postage, etc.),	11 07	
Unexpended balance,	1 77	
		$1,000 00

It gives me great pleasure to have an opportunity here to speak of the kindly assistance which has so uniformly been shown to those engaged in this work by all with whom they have come in contact, and to express our thanks for this assistance and the kindly interest shown in so many ways by the secretary of the Board.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Nov. 28, 1906.

TENTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS
STATE BOARD OF AGRICULTURE.

JANUARY 8, 1907.

REPORT.

To the State Board of Agriculture.

The tenth semiannual report of the Chief of the Cattle Bureau, as required by section 3 of chapter 116 of the Acts of 1902, is herewith respectfully submitted to your honorable Board.

This report gives in detail an account of the work of the Cattle Bureau during the past year up to Dec. 1, 1906, together with any suggestions that seem desirable for legislation that may appear to be necessary to perfect existing laws, and thus render the Cattle Bureau more efficient than at present.

The January report of the Cattle Bureau has heretofore included the period commencing with December 16 of one year and closing December 15 of the following year; but chapter 211 of the Acts of 1905 has changed the beginning of the fiscal year from January 1 to December 1. For this reason it seems better that the Cattle Bureau books shall be closed November 30, in the future; and therefore the present report includes the period between Dec. 15, 1905, and Dec. 1, 1906.

Beside the usual routine work of the Cattle Bureau, which has been carried on much as usual during the past year, there seem to be two topics of special interest; one is the question of a suitable system of meat inspection, and the inspection of animals intended for food at the time of slaughter; and the other is the outbreak of rabies, which has continued during the past year to even a greater extent than it did in 1905.

A complete system of veterinary sanitary science and police contemplates State control of contagious animal diseases, as already provided for in the statutes under which the Cattle Bureau is organized; a suitable system of inspection of milk and dairy products and inspection of premises where milk is produced, which is amply provided for by the dual powers vested in the State Board of Health and the Dairy Bureau of the State Board of Agriculture; and a system of inspection of animals at the time of slaughter, inspection of slaughterhouses and meats. The latter portion of this work in this State is far from ideal, outside of the large slaughtering and packing establishments doing an interstate and export business, which come under the supervision and control of the Bureau of Animal Industry of the United States Department of Agriculture.

While there is ample law on paper providing for the licensing of slaughterhouses, inspection of animals at the time of slaughter, stamping carcasses of animals as fit for food, and prohibiting the sale of meat from diseased animals and the veal from calves under four weeks old, as a matter of fact, the law does not amount to anything, as its enforcement is entirely in the hands of the local boards of health; and the State of Massachusetts never will have a system of meat and slaughterhouse inspection worthy of a civilized community until the enforcement of the law and the supervision of its details is placed in the hands of some strong competent central authority. In most of the larger cities and towns where there is a pretence made of inspecting animals at the time of slaughter, and of inspecting meats, the inspectors are in many instances under the baneful influence of local politics, and in many of the smaller places the inspection is so lax as to practically amount to nothing.

The State law has a provision which seems to be intended to make some information available as to the number of licensed slaughterhouses in the Commonwealth, as section 100 of chapter 75 of the Revised Laws provides that the licensing board or officers in each city or town "shall annually, on or before the first day of June, send to the board of cattle commissioners a copy of every application made to them under the provisions of the preceding section and their action thereon, and a list of all persons with their addresses, who although engaged in the business named in the preceding section on the last day of the previous April failed to make application for a license." A copy of all the sections in the Revised Laws and subsequent acts relating to the Cattle Commission or Cattle Bureau is annually sent to the local board of health in each city and town in the State. As the Chief of the Cattle Bureau succeeded the Cattle Commissioners, it would seem that these reports should continue to be sent to him; although the law is imperfect, as it is not specific enough at present, and good lawyers would take the position that, as the Board of Cattle Commissioners has been abolished, officials in cities and towns cannot be compelled to report to the Chief of the Cattle Bureau. The law is defective, and should be amended if it is desirable to have it operative. Under the provisions of this law, the following cities and towns reported licensing slaughterhouses or packing and canning establishments during the past year: Attleborough, Auburn, Belchertown, Beverly, Boylston, Cambridge, Carlisle, Chicopee, Danvers, Dunstable, Hampden, Haverhill, Holliston, Holyoke, Hudson, Lancaster, Leicester, Lexington, Lunenburg, Maynard, Merrimac, Montague, New Bedford, North Attleborough, North Reading, Northampton, Oxford, Palmer, Pembroke, Pittsfield, Princeton, Raynham, Rockland, Russell, Sandisfield, Seekonk, Sherborn, Shrewsbury, Southborough, Stoughton, Tisbury, Topsfield, Townsend, Wareham, Watertown, Weston, Westwood, Weymouth, Wilbraham and Worthington, — a total of 50 cities and towns, having 117 licensed slaughterhouses.

To show how well the law is lived up to, the following data, taken from the monthly bulletins of the State Board of Health for June, September and November, furnish some interesting information. In a report upon the conditions of the slaughterhouses of the Commonwealth in the three bulletins referred to, it is stated in the September "Bulletin" that: "So much public interest was shown in the result of the examination of all the large and a small number of the small slaughtering houses, as published in the June 'Bulletin,' and so many questions were asked, particularly with reference to the geographical distribution of the smaller establishments, which were reported upon unfavorably and designated merely by a single letter, that it appeared that to widen the inquiry would doubtless serve a useful purpose, although with the very limited force available it was manifestly impossible to cover the entire ground. Therefore, in the latter part of July the secretary of the Board sent to the board of health in every city and town within the Commonwealth a circular letter, asking for a list of slaughterhouses in each place, and information concerning their sanitary condition."

From 103 no replies were received, although the reports to the Chief of the Cattle Bureau show that there are licensed slaughterhouses in 10 of these towns. Twenty-three of these towns were afterward visited by an inspector of the State Board of Health, who found slaughterhouses in 16 of them; only 1 of these places was among the 10 that had previously reported licensing slaughterhouses to the Cattle Bureau office.

One hundred and one reported that they had no slaughterhouses, — a melancholy fact in many cases, as many of these communities ought to be self-supporting, and supply their own meat products. Fifty reported that their slaughtering establishments were in a satisfactory condition and were not visited. Only 8 of these had previously reported licensing slaughterhouses to the Cattle Bureau office.

Twenty-three places which reported the number of slaughterhouses, but not their condition, were not visited; only 2 of these have reported licensing slaughterhouses to the Cattle Bureau office.

Five cities having large slaughtering establishments, namely, Boston, Cambridge, Chicopee, Somerville and Worcester, were reported upon in the June "Bulletin;" only Cambridge and Chicopee have notified the Cattle Bureau of having granted licenses.

The September and October bulletins then describe the conditions in 107 cities and towns, comprising 201 slaughtering establishments; that is, there seem to be slaughtering establishments in at least 210 of the 354 cities and towns of this Commonwealth, including a much larger number of slaughterhouses, and only 50 of these had reported licensing

117 slaughtering establishments to the Chief of the Cattle Bureau.

These bulletins are very interesting, and describe conditions that are in many instances very unappetizing, to say the least, even though their writer is not clothed with the power of description appertaining to Upton Sinclair, or the President's agents for investigating the affairs in "Packing Town."

Chapter 220 of the Acts of 1903 provides as follows: —

SECTION 1. Chapter seventy-five of the Revised Laws is hereby amended by inserting after section one hundred and two the following new sections: — *Section 103.* In a slaughtering establishment wherein inspection and branding is not carried on under the rules and regulations for the inspection of live stock and other products, established by the United States department of agriculture in accordance with acts of congress in force on the fifteenth day of June in the year nineteen hundred and one, the carcasses of animals slaughtered under the provisions of the four preceding sections shall at the time of slaughter, if not condemned, be stamped or branded by the inspector thereof in like manner as those inspected by the United States bureau of animal industry for interstate trade, by a stamp or brand designed for the purpose by the cattle bureau of the state board of agriculture, which shall be furnished by it to the board of health of a city or town applying therefor. Such stamps shall be uniform in design throughout the Commonwealth, but shall contain the name of the city or town in which they are used. *Section 104.* The carcasses of animals slaughtered under the provisions of the five preceding sections and not stamped or branded as provided in the preceding section shall be deemed unfit for human food and shall not be sold or offered for sale. Whoever sells, or offers for sale, or has in his possession with intent to sell, a carcass or any part thereof required by the provisions of the preceding section to be stamped or branded, which has not been stamped or branded as therein provided, shall be punished by a fine of not more than one hundred dollars or by imprisonment for not more than sixty days, or by both such fine and imprisonment.

SECTION 2. Section one hundred and five of said chapter seventy-five, as amended by section two of chapter three hundred and twelve of the acts of the year nineteen hundred and two, is hereby further amended by striking out the word "four," in the second line, and inserting in place thereof the word: — six, — so as to read as follows: — *Section 105.* The provisions of the six preceding sections shall not apply to a person not engaged in such business, who, upon his own premises and not in a slaughter house, slaughters his own neat cattle, sheep or swine, but the carcass of any such animals shall be inspected by an inspector at the time of slaughter, unless said animal is less than six months old or has been duly inspected under the provisions of chapter ninety, within six months prior to such slaughter and a certificate of health has been delivered to the owner or person in charge thereof.

This law was formerly contained in sections 103 and 104 of chapter 75 of the Revised Laws, which were repealed in 1902, on the ground that it made an unwarranted expense for many small towns, near large cities, which were required to go to quite an outlay each year to inspect animals killed for food in the neighboring municipalities. The law was re-enacted in 1903, because it was thought that the carcasses of animals killed for food ought to be inspected and branded.

The law is contradictory, because section 105 of chapter 75 of the Revised Laws permits a farmer who is not engaged in slaughtering as a business to kill animals on his own premises which are under six months old, or which have been inspected within six months and a certificate of health given to the owner or person in charge by the inspector of animals, as provided for in section 18 of chapter 90 of the Revised Laws, without notifying the board of health. Yet, if the carcass of an animal so killed is offered for sale, the preceding section provides that a carcass not so stamped or branded shall be deemed unfit for human food and shall not be sold or offered for sale, and fixes a penalty for so doing that may include a fine or imprisonment, or both, not exceeding one hundred dollars and sixty days in jail.

Therefore, a farmer who wishes to kill and dispose of a pig or calf under the provisions of section 105 has to notify the board of health to send an agent to stamp the carcass. Under the provisions of section 103 of chapter 75 of the Revised Laws, the Cattle Commission in 1901 and 1902 furnished 269 of these stamps to 227 cities and towns when ordered by the boards of health. Since this law was re-enacted in 1903, 163 of these stamps have been furnished to 116 cities and towns when ordered through the Cattle Bureau office by local boards of health. Fifty-two of these cities and towns had no stamps prior to the re-enactment of the law in 1903; the others ordered them to replace stamps worn out or lost. Twenty-six cities and towns have ordered stamps during 1906, since the revelations of the packing town investigators led to a demand for a better inspection, and the United States government issued stricter regulations for establishments doing an interstate or export business, and increased its force of inspectors.

While the law provides that boards of health are to be furnished these stamps through the Cattle Bureau, it provides no penalty for any one having a similar stamp made elsewhere, or for an unauthorized person having such a stamp in his possession, or using such a stamp.

Reports come from various sources of the misuse of such stamps. In the western part of the State it has been reported that in a small town near the Connecticut River the son of an owner of a slaughterhouse, where animals are killed to be marketed in a neighboring city, was appointed agent of the board of health to stamp the carcasses of animals killed there. This agent having left town, a younger brother, a lad twelve or fourteen years of age, now does the stamping; and if he is absent, the butcher who slaughters there goes to the house and obtains the stamp and uses it himself. In this way many cattle and calves are stamped as fit for food that should not be.

A report comes from a physician who is a member of the board of health in a town within twenty miles of Boston, that the chairman of the selectmen thinks that licensing slaughterhouses and stamping carcasses is a humbug; and he has had a stamp made, and has the inspector of animals stamp the carcasses of animals killed at an unlicensed slaughterhouse. While the board of health in this town has one of these stamps, it is never called upon to send an agent to mark the carcasses of animals killed for food. Upon being told that there seemed to be no provision of law for a penalty for having such a stamp and its unauthorized use the member of the board of health referred to said that he thought he would see that the proprietor of the slaughterhouse received a tip to buy his own stamp; that, as the meat was not sold in his town, it was no menace to its inhabitants, and the butcher might as well do the stamping himself, and thus save the expense of having it done.

The health authorities in some cities and towns think that it might be better to do away with this stamping, as carcasses of animals that are unfit for food are frequently branded as having been inspected; and it would be better in the cities and larger towns for the agents of boards of health to use their own judgment as to what is or is not fit for human food rather than to have animals marked as fit for human food that should not be looked upon as such. The Massachusetts law provides that calves under four weeks old shall not be considered fit for veal, yet many calves are killed for food that are only a few days old.

The United States rules and regulations for meat inspection conflict with the State law, as they require calves to be three weeks old. As a matter of fact, there seems to be little evidence that young calves are dangerous as an article of food; the objection is largely a matter of sentiment, and immature calves have less nutritive value than older, well-fattened animals. Either the State law should be enforced, if it is to remain on the statutes; or, if not desirable as it is, it should be revised to coincide with the rules and regulations of the United States Bureau of Animal Industry, or repealed altogether.

While the United States law provides for an inspection of animals slaughtered for export or interstate commerce, it does not provide for an inspection of animals shipped from one State into another; and old, emaciated cows, frequently suffering from disease, and immature calves, can be shipped from Maine, New Hampshire, Vermont, New York or other States into Massachusetts, to be killed for "beef" or "veal" at slaughterhouses where there is no United States government inspection, and the local inspection is incompetent or lax. While the United States Bureau of Animal Industry inspection at the large abattoirs where animals are killed and meat is prepared for export and interstate commerce gives the people of Massachusetts a certain amount of protection, as most of the meat consumed here either comes from the west or from animals killed at these establishments, yet it remains a disgrace to this Commonwealth that Massachusetts does not give her citizens as good an inspection and the same protection from the evils of diseased cattle, immature calves and tuberculous swine killed at the little slaughterhouses around the State, as is afforded them by the United States government at the large packing houses and abattoirs where an export and interstate business is conducted. These conditions are unworthy of a civilized Commonwealth, and call for investigation and legislation to remedy these evils.

Prior to 1899 the law under which the Board of Cattle Commissioners operated called for the annual appointment in cities and towns of "inspectors of animals and provisions" under the control of the Board; but when it was recodified in 1899 it was changed to provide only for the appointment of "inspectors of animals" whose duties are confined entirely to the work of eradication and control of contagious diseases among live animals, and the inspection of animals slaughtered for food and of meats was placed entirely in the hands of the local boards of health. In many instances it would seem that there is need of some legislation that will give a suitable inspection law to the State, and provide for its enforcement by some competent central authority; although there is not any desire on the part of the Chief of the Cattle Bureau to have these powers, as the suppression and eradication of contagious animal diseases seems to be primarily the object for which the Bureau was created.

The law also provides that the Chief of the Cattle Bureau may issue rules and regulations for the inspection of meat, which shall conform to the regulations of the United States Bureau of Animal Industry for the inspection of meat for export and interstate commerce, subject to the approval of the Governor and Council.

Rules and regulations in accordance with this provision of the law were approved in Council May 21, 1902, and have been furnished to all the local boards of health in the cities and towns of the Commonwealth.

The portions of the law referred to have led to a great number of inquiries being made of the Chief of the Cattle Bureau since the new United States inspection law went into effect, and stricter rules and regulations for the guidance of the inspectors of the United States Bureau of Animal Industry were issued by the Secretary of Agriculture, which has entailed an immense amount of extra correspondence upon him.

RABIES.

Rabies has continued to be prevalent and troublesome during 1906 to even a greater extent than it was the preceding year.

At the time of making the eighth semiannual report, in January, 1906, it was stated that there were in quarantine at that time 31 dogs, 2 horses and 1 cow which had been exposed to the bites of rabid dogs. Eight dogs, 7 in Boxford and 1 in Topsfield, were released from quarantine January 10, at the expiration of ninety days from the time of exposure, none having shown any evidence of disease. Two in Upton were released January 30, at the expiration of the same period from the date of exposure, still in a healthy condition. On February 7, 1 dog, and on March 3, 3 dogs and 1 cow, were released in Marlborough, all of which had remained healthy for three months from the date of exposure. On January 23, 2 dogs were released from further observation in Milford; and on March 23, 3 dogs were released in Hopkinton. On February 14, 7 dogs were released in Dracut which were exposed November 16.

Two horses and 1 dog were in quarantine in Weymouth Jan. 1, 1906, which were bitten by a stray dog December 11. Early in March one of the horses developed symptoms of rabies, and was killed March 5; a microscopic examination of its brain by Dr. Frothingham confirmed the diagnosis of rabies. The other horse and the dog were released March 21. April 21 the dog showed symptoms of rabies, and was killed, four months and ten days after he was bitten.

At the commencement of 1906, 4 dogs were in quarantine at Mount Washington, which were exposed to the bites of a stray dog November 27; 2 of these were released April 21; 2 were killed Dec. 30, 1905, 1 because it had rabies, the other because the owner decided that it was wiser to have it destroyed than to run any further risk.

Between Jan. 1, 1906, and Dec. 1, 1906, 1,163 animals have been entered upon the Cattle Bureau records as having rabies or as having been exposed to the bites of rabid dogs.

Cases of rabies have occurred in the counties of Berkshire, Franklin, Hampshire, Hampden, Worcester, Middlesex, Essex, Suffolk, Norfolk, Bristol, Plymouth and Dukes.

The following table shows the species of animal and disposition of the cases: —

	Dogs.	Cattle.	Horses.	Goats.	Pigs.	Cats.
Killed or died with rabies, ...	293	38	5	-	-	-
Killed by owners or died in quarantine, not rabid.	256	-	-	-	2	-
Reported as rabid, but found free from the disease.	62	-	-	-	-	-
Released from quarantine, ...	380	15	4	2	-	-
Animals died, still undecided, . .	-	-	1	-	1	-
Still in quarantine December 1, . .	98	4	1	-	-	1
Totals, ...	1,089	57	11	2	3	1
Grand total, ...	1,163	-	-	-	-	-

The veterinarian of the Boston Board of Health reports that up to December 1 there had been 38 cases of rabies among dogs in that city, of which 5 were already entered on the Cattle Bureau records. In addition to the above cases, there is a dog to be added that died in Weymouth that was in quarantine Jan. 1, 1906, making a total of 327 cases of rabies in dogs in Massachusetts during eleven months, ending November 30.

In addition to the 5 horses that died that were bitten in 1906, there should be added 1 horse in Weymouth remaining in quarantine at the end of 1905; this makes 6 horses to die from rabies prior to December 1 during 1906. The horse and pig referred to as having died, and cases still undecided, were bitten by dogs believed to have been rabid;

but Dr. Frothingham has not yet been able to decide that these animals died of rabies. The examination of their brains is not yet finished.

In addition to the horse and pig spoken of above, Dr. Frothingham has examined the brains of 151 animals and 1 boy, in order to decide positively as to whether the disease was rabies or not. The results of these examinations has shown that 110 dogs, 7 cows, 2 horses and 1 boy were suffering with rabies at the time of death, and that 31 dogs and 1 cow suspected of having rabies were free from this disease.

It is often important to know positively whether an animal had rabies, or did not have it. When dogs have bitten people, other dogs or animals, if it is ascertained that the dog was rabid, the people have an opportunity of taking the Pasteur treatment, and other animals which have been exposed can be destroyed or quarantined. On the other hand, if a dog bites any person or other dogs, or appears in a town where he does not belong, acting strangely, and is killed by the authorities, and an examination of the brain shows the animal to have been free from rabies, it becomes at once apparent that there is nothing to fear from the bite of such a dog. Of the 293 dogs reported as having rabies, it will be seen that a microscopic examination confirmed the diagnosis in 110 cases. These examinations have been made whenever possible if supposed rabid dogs had bitten people or other animals. The other mad dogs showed unmistakable evidence of rabies; in many instances there was the history of a bite from a rabid dog. Of 62 dogs reported as having rabies, but found free from the disease, it will be seen that the heads of 31 were examined and found free from evidences of the disease, thus setting at rest the fears of persons bitten, and their relatives and friends. The other 31 either showed no evidences of disease when examined by agents during life, or, if killed, they had done no harm, and there was no reason for believing them to have been rabid.

Five or 6 dogs died in quarantine from some other cause than rabies; the others that were killed were destroyed by owners who did not care to keep them in quarantine, or were afraid they might develop disease, and would not take the risk. Undoubtedly some of these dogs would have developed trouble later if they had not been killed.

The heads of some cattle and horses have been examined, in order to help the owners to prove their claims for damages from the county dog funds, in instances where any question arose as to whether the animal in question died from rabies or not. Other cases recorded were so clear that a microscopic examination was unnecessary.

In the case of the boy spoken of above, no Negri bodies could be found in the brain; it was therefore necessary to inoculate guinea pigs, which in time developed unmistakable symptoms of rabies, thus furnishing conclusive proof of the cause of the boy's death.

The boy in question lived in Springfield, and was bitten by a neighbor's dog about the first of May. The dog was later taken to the hospital of a veterinarian in the vicinity, who did not suspect that the animal had rabies, but called the dog's disease "brain fever;" finally, it died without a correct diagnosis being made.

The boy was taken ill June 24, and died July 4 with symptoms of brain trouble, which was attributed variously to possible rabies, or to a blow on the head with a ball while playing base ball. The brain was secured by an agent of the Cattle Bureau, and brought to the Harvard Medical School, where Dr. Frothingham's examination decided the matter. If the dog which bit the boy had been seen by a competent man, the poor little fellow might have been saved by the Pasteur anti-rabic treatment, and thus spared the agony of a horrible death.

In addition to this case, there have been at least a half a dozen other deaths among human beings in Massachusetts during the past year as the result of the bites of rabid dogs, to say nothing of the expense, worry and loss of time involved for the large number of persons who have had to take the Pasteur treatment in order to prevent the development of this disease.

If the persons who have suffered and died, those who have had to take the Pasteur treatment, and their anxious and afflicted families and friends, could have their way, this outbreak of rabies would be brought to a speedy termination by bringing to an end a system of dog management that has driven the sheep industry from Massachusetts, and allows this privileged species of domestic animal to prowl around destroying human life and other domestic animals and fowls, — an animal that under these conditions may be as much a menace to the welfare of the community as the wolf or the fox. The dog should be a luxury, and not a necessity; the tax upon him should be higher, — at least $5 for a male or spayed female, and $10 for an unspayed female; and there should be no kennel tax, as at present. Owners of dogs should be compelled to keep them under control at all times. If allowed to run at large at all, they should be required to be properly and securely muzzled, otherwise owners should be compelled to keep them on their own premises, or when on the street they should be kept in leash.

The dog-licensing law should be strictly enforced, and also the provision of the law that requires that every licensed dog shall have a collar around his neck, with a plate with the owner's name and license number engraved thereon.

Some of the cities and towns of the State have during the past year issued orders that dogs shall be muzzled or restrained from running at large, under the authority given to mayors and aldermen of cities and selectmen of towns by section 158 of chapter 102 of the Revised Laws; but there seems to have been very little concerted action, one community issuing an order just as a similar one went out of effect in an adjoining town; and in many instances the police seem to have paid little or no attention to enforcing these orders. In some quarters there seems to be more sympathy for the dog and more people to stand up for his rights than there are people to sympathize with the victims of his bites, or to stand up for the rights of holders of other property. An order has just been approved by the Governor and Council giving the Chief of the Cattle Bureau authority to issue muzzling or restraining orders, where the local authority neglects or refuses to do so; and by this means it is hoped that a greater amount of co-operation among cities and towns in infected localities can be secured.

During the earlier part of the year there was a great deal of rabies in the western counties of the State; while it has subsided somewhat there, later it has prevailed in other localities. There was quite an outbreak in Bristol County in the autumn, and last summer there was a small outbreak in Dukes County, caused by a dog taken to Cottage City by a summer resident, who took the dog there from Milton.

At present the chief centers of infection seem to be the Merrimac valley, Boston and the surrounding cities and towns, and a group of towns comprising Brockton, Whitman, Easton, Taunton and Bridgewater.

One difficulty in managing rabies is due to the varying period of its incubacy, as a dog may develop rabies in two or three weeks after being bitten, or it may go four or five months before showing symptoms. Three cases have occurred during the past year where dogs have gone from four to five months before showing symptoms; all of them were in quarantine for ninety days from the time of being bitten, and then released as safe, to develop symptoms later, and in one case to do a great deal of mischief before being killed. It may be necessary in future to make the period for holding dogs in quarantine longer. Where a dog is bitten by another dog known to have rabies, it is erring on the side of safety to have it immediately killed, and this is the wisest course to pursue to protect the health of the community.

Rabies is unknown in Australia, because every dog brought there is held in quarantine until it is safe to allow it to run at large; it has been stamped out in England, and is kept out by rigid quarantine laws.

It can be eradicated and controlled in any community, when the people wake up to the necessity for doing so. Unfortunately, Massachusetts is not an island, and when it is eradicated it can be reintroduced at any time by dogs from adjoining States. This in a measure may be safeguarded against by forbidding any person or transportation company bringing a dog into the State without a permit from the Chief of the Cattle Bureau, and having dogs held in quarantine for six months after arrival.

During the past year arrangements have been made for having material for the Pasteur anti-rabic treatment sent from the laboratory of the New York City board of health to the State Hospital at Tewksbury and the Boston City Hospital. At each of these hospitals a number of cases have been treated. Physicians have also had material sent for use on their patients in a number of instances, thus avoiding the time and expense necessary for taking the treatment in New York. If the present state of affairs should continue, it might be desirable for the State of Massachusetts to establish a laboratory for the preparation of this material; but if history repeats itself, the malady will disappear until we have another surplus of curs and mongrels, and the disease is reintroduced.

GLANDERS.

The number of cases of glanders and farcy in Massachusetts during 1906 shows a slight decrease from the previous year, although the diminution during 1906 is not as marked as it was in 1905.

While the statistics to be given in the future are to be included between November 30 of one year and December 1 of the succeeding year, and the following table gives the cases or suspected cases until Dec. 1, 1906, only, there were 21 horses killed with glanders between December 1 to 15 inclusive, making the total number killed during the year from Dec. 16, 1905, to Dec. 15, 1906, inclusive, to be 33 less than during the corresponding period the year before, — 13 less in Boston and 20 less outside of this city.

It is also encouraging to note that in the two largest cities of the State outside of Boston, namely, Worcester and Fall River, which are so far removed that they may be looked upon as distinct centers of infection, there has been a continued decrease in the number of cases; in fact, Fall River may be looked upon as almost free from glanders, as only 4 cases were reported there, while a few years ago there were 35 or 40 cases there each year.

The results of the work in connection with glanders are shown in the following table: —

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Acton,	–	–	1	–	1	–
Acushnet,	–	–	1	–	1	–
Adams,	1	1	–	–	–	1
Amesbury,	1	–	–	–	–	1
Amherst,	3	–	–	–	–	3
Andover,	2	2	2	8	–	–
Arlington,	13	9	5	6	–	8
Ashby,	2	1	–	–	–	2
Athol,	–	–	–	2	–	–
Attleborough,	1	–	5	3	4	–
Auburn,	2	1	2	1	–	–
Barnstable,	–	2	–	2	–	–
Barre,	1	–	1	1	–	–
Bedford,	–	–	2	1	2	–
Belchertown,	–	–	–	1	–	–
Bellingham,	2	1	–	1	–	2
Belmont,	4	–	1	–	–	3
Berkley,	–	–	–	1	–	–
Bernardston,	–	1	–	–	–	–
Beverly,	3	7	–	–	–	3
Billerica,	–	1	2	1	2	–
Blackstone,	1	1	1	1	–	–
Bolton,	–	–	–	1	–	–
Boston,	210	20	194	9	–	16
Boxford,	–	1	–	–	–	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Boylston, . .	4	–	2	3	–	2
Braintree, . .	1	1	4	1	3	–
Bridgewater, . .	1	4	1	–	–	–
Brockton, . .	1	1	1	4	–	–
Brookline, . .	10	5	2	3	–	8
Cambridge, . .	55	12	42	75	–	13
Canton, . .	–	1	5	1	5	–
Carlisle, . .	–	–	–	1	–	–
Charlton, . .	2	–	–	–	–	2
Chelmsford, . .	2	–	–	–	–	2
Chelsea, . .	14	–	12	2	–	2
Chicopee, . .	–	–	–	1	–	–
Clinton, . .	1	–	–	–	–	1
Colrain, . .	–	1	–	–	–	–
Concord, . .	–	–	1	–	1	–
Danvers, . .	1	–	–	2	–	1
Dartmouth, . .	1	1	3	1	2	–
Dedham, . .	4	1	1	1	–	3
Douglas, . .	–	1	1	1	1	–
Dover, . . .	2	9	–	1	–	2
Dracut, . .	–	–	1	–	1	–
Easthampton, .	–	–	–	2	–	–
East Longmeadow, .	–	–	–	1	–	–
Easton, . .	2	–	–	–	–	2
Everett, . .	8	2	16	2	8	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Fairhaven, . .	1	–	1	1	–	–
Fall River, . .	14	37	4	–	–	10
Falmouth, . .	–	–	1	–	1	–
Fitchburg, . .	–	2	–	–	–	–
Foxborough, . .	–	–	–	1	–	–
Framingham, . .	1	1	–	1	–	1
Franklin, . .	2	–	2	–	–	–
Gardner, . .	5	17	–	–	–	5
Gloucester, . .	–	1	–	–	–	–
Grafton, . .	1	2	2	–	1	–
Greenfield, . .	–	2	–	1	–	–
Groton, . .	–	1	–	–	–	–
Halifax, . .	–	1	–	–	–	–
Hanover, . .	–	–	1	1	1	–
Hardwick, . .	–	2	1	–	1	–
Harwich, . .	1	–	–	–	–	1
Haverhill, . .	–	4	1	2	1	–
Heath, . . .	–	–	–	1	–	–
Hingham, . .	3	1	–	–	–	3
Holden, . .	3	–	–	–	–	3
Holliston, . .	4	–	–	–	–	4
Holyoke, . .	–	–	1	1	1	–
Hubbardston, .	1	–	–	3	–	1
Hudson, . .	1	1	–	–	–	1
Hyde Park, . .	1	1	2	–	1	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Ipswich, . .	–	1	–	–	–	–
Kingston, . .	1	–	–	–	–	1
Lancaster, . .	–	2	–	–	–	–
Lawrence, . .	4	5	20	18	16	–
Leicester, . .	–	–	1	2	1	–
Lenox, . . .	–	–	5	–	5	–
Leominster, . .	1	1	–	1	–	1
Lexington, . .	2	10	4	1	2	–
Lincoln, . .	–	1	–	–	–	–
Lowell, . . .	9	3	6	6	–	3
Ludlow, . .	–	–	–	1	–	–
Lunenburg, . .	–	–	–	2	–	–
Lynn, . . .	6	4	12	2	6	–
Lynnfield, . .	–	–	2	–	2	–
Malden, . .	2	2	3	–	1	–
Mansfield, . .	–	1	–	–	–	–
Marblehead, . .	–	–	1	–	1	–
Marlborough, . .	4	1	–	–	–	4
Marshfield, . .	–	–	2	–	2	–
Maynard, . .	–	–	–	1	–	–
Medfield, . .	–	–	–	1	–	–
Medford, . .	3	2	5	–	2	–
Melrose, . .	2	–	1	–	–	1
Mendon, . .	1	–	–	–	–	1
Merrimac, . .	–	–	1	–	1	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Methuen,	–	1	–	1	–	–
Milford,	1	–	1	–	–	–
Millbury,	–	–	1	–	1	–
Milton,	4	1	3	–	–	1
Montague,	–	1	–	–	–	–
Nahant,	1	–	–	–	–	1
Natick,	2	–	3	1	1	–
Needham,	–	–	–	1	–	–
New Bedford,	10	–	7	–	–	3
Newbury,	–	–	–	1	–	–
Newburyport,	1	1	1	–	–	–
Newton,	6	2	6	3	–	–
Norfolk,	–	–	3	–	3	–
North Adams,	1	–	–	–	–	1
Northampton,	–	–	–	1	–	–
North Andover,	1	5	1	1	–	–
North Attleborough,	1	2	2	–	1	–
Northborough,	4	–	–	–	–	4
Northbridge,	–	1	–	1	–	–
North Brookfield,	–	–	–	1	–	–
Northfield,	–	2	–	–	–	–
North Reading,	–	–	1	–	1	–
Norton,	–	–	1	–	1	–
Norwood,	–	–	–	2	–	–
Orange,	–	2	–	1	–	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Oxford,	5	–	–	2	–	5
Palmer,	–	–	–	1	–	–
Paxton,	–	–	1	–	1	–
Peabody,	–	2	6	1	6	–
Pepperell,	–	1	1	–	1	–
Pittsfield,	–	–	1	–	1	–
Plymouth,	–	1	–	1	–	–
Plympton,	–	–	–	1	–	–
Princeton,	2	10	1	2	–	1
Quincy,	2	1	1	3	–	1
Randolph,	1	1	–	–	–	1
Reading,	–	–	2	–	2	–
Rehoboth,	–	–	4	1	4	–
Revere,	1	–	1	–	–	–
Rochester,	–	1	1	–	1	–
Royalston,	–	1	1	2	1	–
Russell,	–	–	–	1	–	–
Rutland,	–	–	–	1	–	–
Salem,	2	1	3	–	1	–
Salisbury,	–	–	–	1	–	–
Saugus,	1	4	–	–	–	1
Savoy,	–	–	–	1	–	–
Seekonk,	2	–	2	1	–	–
Sharon,	–	–	1	–	1	–
Sheffield,	–	–	–	1	–	–

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Shirley,	2	–	–	–	–	2
Shrewsbury,	2	1	2	–	–	–
Somerville,	28	5	38	5	10	–
Southbridge,	1	–	–	–	–	1
Southwick	–	1	–	–	–	–
Spencer,	–	–	–	1	–	–
Springfield,	2	1	–	1	–	2
Sterling,	1	–	4	2	3	–
Stoneham,	–	–	2	–	2	–
Stoughton,	3	–	–	–	–	3
Stow,	1	1	–	2	–	1
Sudbury,	3	3	–	–	–	3
Sutton,	1	–	–	3	–	1
Swampscott,	2	–	2	2	–	–
Templeton,	–	–	–	1	–	–
Tewksbury,	–	–	1	1	1	–
Topsfield,	2	–	–	–	–	2
Townsend,	–	–	–	1	–	–
Upton,	–	–	1	–	1	–
Uxbridge,	2	1	–	–	–	2
Wakefield,	6	3	6	2	–	–
Walpole,	1	–	2	5	1	–
Waltham,	2	2	1	3	–	1
Ware,	–	1	–	1	–	–
Watertown,	7	7	5	1	–	2

CITY OR TOWN.	1905.		1906.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Wayland, . .	1	1	–	–	–	1
Wellesley, . .	–	1	3	1	3	–
Wellfleet, . .	–	3	–	–	–	–
Wendell, . .	1	–	–	–	–	1
West Boylston, .	–	1	–	1	–	–
Westford, . .	–	–	–	1	–	–
Westminster, . .	2	1	–	–	–	2
Westport, . .	3	–	–	–	–	3
Westwood, . .	10	4	3	–	–	7
Weymouth, . .	2	–	2	2	–	–
Whitman, . .	–	–	1	1	1	–
Wilbraham, . .	–	–	–	1	–	–
Winchendon, . .	–	–	1	3	1	–
Winchester, . .	2	–	4	14	2	–
Winthrop, . .	–	–	1	2	1	–
Woburn, . .	1	1	3	2	2	–
Worcester, . .	60	4	44	12	–	16
Wrentham, . .	–	–	–	2	–	–
Totals, . .	624	275	570	295	–	–

NOTE. — There was one case reported from Egremont, but upon investigation the animal was found to belong in New York State. At the close of the year, November 30, there were two cases not disposed of, the animals being held for further mallein tests.

Dec. 1, 1906, all cases of glanders or suspected glanders had been disposed of except the two horses already mentioned, which had reacted to mallein and were held for a retest. Only one error of diagnosis has been made. A mare in Cambridge, kept at a stable where all the horses were tested with mallein the preceding year, commenced to lose flesh and run down. As she had been tested several times the year before and given more or less of a reaction on a number of occasions, she was killed; but an autopsy showed no active lesions of glanders, only an old calcareous nodule in one lung and a similar one in a lymphatic gland near the liver, her condition being due to a diseased molar. The Commonwealth reimbursed the owner for the loss of this animal, the value being set at $90.

A horse was killed in New Bedford in September, which had farcy; the owner was not satisfied that this was the fact, and petitioned the Superior Court of Bristol County to assess damages; but when the case was called for trial early in December the owner and his witnesses did not appear, although the Chief of the Cattle Bureau was present with witnesses and counsel from the Attorney-General's office to defend the action. It is unlikely that this case will ever come to trial.

During 1906 there has been more trouble due to persons breaking quarantine than in any previous year for many years; and this, with the prosecution of persons for disposing of glandered horses, has led to the necessity for a greater number of cases in court than usual. Two persons have disposed of horses quarantined on suspicion of having glanders, and two have disposed of cows quarantined on suspicion of having tuberculosis. While it is not unusual for persons to sell animals suffering from a contagious disease before the quarantine is imposed, in most instances it being impossible to prove that the owner had knowledge of or reasonable cause to suspect the presence of a contagious disease, yet it is very rare for any one to defy the law, and dispose of an animal duly quarantined by an inspector of animals.

The cases referred to occurred in South Hadley and Norfolk. The horse in South Hadley has not been traced, and it is not known whether it had glanders or not. It is not unlikely that it was removed from the State. The owner was fined $25 at the district court in Northampton, — a sum in excess of the value of the horse, judging from the description given. The owner of the horse in Norfolk was fined $10 in the district court in Franklin for removing the horse, the court showing leniency because the State had already killed two horses owned by the defendant, and the third horse had been traced and killed.

In the report made Jan. 10, 1906, an account was given of three men having been fined in Fitchburg for trading around a pair of glandered horses in the summer of 1905. These defendants appealed, but before the cases came to trial in Worcester in January they withdrew their appeals and settled. These horses were traced back, after several months' search, to Oxford. It was ascertained that they came from a farm where the State had already killed horses with glanders. This pair with another horse was taken away in July, 1905, by the owner's son and a man who had previously worked for him, and traded off in Barre and Phillipston, whence the pair afterwards killed at Ashby were taken to Fitchburg. In the district court at Webster the owner and his former employee were fined $100 each, and the son, a youth of about twenty years of age, was fined $50, the latter receiving a lighter fine partly because of his youth, and partly because he caught glanders from the horses on the trip, and had been ill with the disease for several months, part of the time at the Worcester hospital. Appeals were taken, and later at the Superior Court in Worcester the boy's case was placed on file; and the two men pleading guilty, their fines were reduced to $75 and $50, the larger one for the owner, the smaller one for the employee, on the ground that the original fines were proportionately much larger than those imposed for a similar offence in the district court at Fitchburg.

In April a Rehoboth man was fined $20 in the district court at Taunton for removing a horse, knowing or having reasonable cause to believe it had glanders.

In Attleborough a few days later another man was fined $25 for removing the same horse to Providence, where he was unable to dispose of it; he then brought it back to Attleborough and kept it in his barn basement for two or three weeks, where it was located by agents of the Cattle Bureau and killed. The man was also fined $20 for not reporting a case of contagious disease to the Chief of the Cattle Bureau or its agents or inspectors.

In August a stable keeper in Whitman was tried at the district court in Abington for sending a glandered horse to Boston to be sold. The court discharged the defendant, on the ground that the Commonwealth did not prove that he knew or had reasonable cause to believe that the horse had a contagious disease.

At the same time a veterinary surgeon who saw the horse in Whitman was tried on a complaint charging him that he did not report in writing to the Chief of the Cattle Bureau or one of its agents or inspectors a case of contagious disease in a domestic animal. His lawyer argued that there is nothing in the law which requires this. Section 11 of chapter 90 of the Revised Laws reads as follows: —

> SECTION 11. The board of health of a city or town, any member or agent thereof or any other person who has knowledge of or reason to suspect the existence of any contagious disease among any domestic animals in this Commonwealth, or that any domestic animal is affected with such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give notice thereof in writing to the board of cattle commissioners or to any of its members, agents or inspectors. Whoever fails to give such notice shall be punished by a fine of not more than one hundred dollars; but no such notice shall be required in the city of Boston relative to glanders, farcy or rabies, which shall be cared for by the board of health of said city. Upon the receipt of such notice, the board shall inspect or cause its authorized agent to inspect any such animals, and if upon such inspection said board or agent suspects or has reason to believe that contagion exists, it or he shall proceed according to the provisions of sections eighteen to twenty-one, inclusive.

His counsel took the ground that nothing in chapter 116, Acts of 1902, providing for a Chief of the Cattle Bureau of the State Board of Agriculture, to have the powers and duties formerly devolving upon the Cattle Commission, specifies that any one shall make any such reports to him, his agents or inspectors. The court sustained this view of the case, and dismissed it. Hence the law is defective, and further legislation is necessary to perfect it. Steps will be taken to have the present Legislature so amend section 11 of chapter 90 of the Revised Laws as to render it operative.

In order to obtain evidence and prepare some of these cases for prosecution, it was found necessary to obtain the services of some one having detective ability and police experience. The Cattle Bureau has been fortunate in securing the services of a retired Boston police sergeant, Mr. Walter E. Bruce of Townsend, who has had an extensive police experience in the Boston courts, and has been of great assistance in securing evidence which resulted in conviction in a number of the cases cited above.

There were fewer stables where the mallein test was applied during 1906 than during the preceding year, only half a dozen in all, but the number of animals tested was larger, as one stable comprised 69 horses.

The following table shows the amount of work done in testing horses in stables where outbreaks of glanders have occurred: —

Stable Tests with Mallein.

Cities and Towns.	Number of Stables.	Number of Horses tested.	Released on First Test.	Released on Subsequent Test.	Killed, with Clinical Evidence of Glanders.	Held for Further Tests.
Andover, . .	1	5	5	–	–	–
Arlington, . .	1	6	6	–	–	–
Cambridge, . .	2	69	30	34	3	2
Lawrence, . .	1	25	12	6	7	–
Winchester, . .	1	16	9	5	2	–
Totals, . .	6	121	62	45	12	2

Reports from rendering establishments, as required by section 111 of chapter 75 of the Revised Laws, continue to be of value, as in this way a number of cases of glanders or farcy are heard of that would not have been reported in any other way. This affords an opportunity for seeing that stables from which these animals come are properly disinfected, and for having other horses or mules kept in them inspected by agents of the Cattle Bureau or by inspectors of animals, in order to ascertain if any other diseased animals are kept in them.

The following table shows that 53 cases of glanders or farcy were reported by the renderers as coming from outside the limits of the city of Boston, of which the Chief of the Cattle Bureau had no previous notification: —

Reports of Rendering Companies, 1906.

Rendering Companies.	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not previously reported.
Guy U. Barnes Rendering Company, Fall River.	14	4	–	4	1
John J. Burke, South Sherborn.	3	2	–	2	1
C. S. Bard, Haverhill, .	1	1	–	1	–
Lowell Rendering Company.	31	3	–	3	–
Muller Bros., North Cambridge.	35	71	5	66	14
Jas. E. McGovern, Lawrence,	21	23	–	23	3
New Bedford Extractor Company.	1	–	–	–	–
W. H. Nankervis, Marlborough.	8	–	–	–	–
New England Rendering Company, Brighton.	43	59	22	37	17
Parmenter & Polsey Fertilizer Company, Peabody.	20	16	–	16	2
N. Roy & Son, South Attleborough.	7	8	–	8	3
Worcester Rendering Company, Auburn.	17	39	–	39	8
Whitman & Pratt Rendering Company, No. Chelmsford.	13	6	–	6	1
N. Ward Company, Boston,	43	171	142	29	3
Fitchburg Rendering Company.	1	–	–	–	–
The Home Soap Company, Worcester.	7	3	–	3	–
William Higgins, Peabody, .	2	2	–	2	–
William Lavery, Amesbury,	1	1	–	1	–
Totals, ...	268	409	169	240	53

The employment of a man with a horse and wagon to disinfect stables within ten miles of Boston outside of the city limits where glandered horses have been kept, and to see that blacksmith shops are cleaned up where diseased animals have been shod, and to report upon the condition of public watering troughs, has been continued, with gratifying results.

In Fall River and Worcester men have also been employed to attend to disinfecting stables for people who did not understand the importance of this work, or the best methods of doing it. Last October the Cattle Bureau was unfortunate in losing by death the services of Joel W. Bent, the agent who had charge of disinfecting stables in cities and towns outside of Boston, who had been a most valuable and painstaking assistant ever since this part of the work was inaugurated a few years ago.

As in years past, most of the veterinary work in connection with glanders has been done by Dr. Howard P. Rogers, and the laboratory work by Dr. Langdon Frothingham. In closing this portion of the report, it would be incomplete if an acknowledgment of appreciation of their valuable services were omitted.

Annual Inspection of Neat Cattle, Farm Animals, and Premises upon which the Former are kept.

Late in September the following circular letter was sent to the inspectors of animals in the cities and towns of the State, together with the necessary books in which to record the results of their work, and blank forms of certificates of health to be given owners in conformance with section 18, chapter 90 of the Revised Laws: —

Commonwealth of Massachusetts,
Cattle Bureau of the State Board of Agriculture,
Room 138, State House, Boston, Sept. 20, 1906.

Directions to Inspectors of Animals.

Inspectors of animals are hereby directed to make a general inspection of the neat stock in their respective towns, and incidentally other farm animals, to commence October 1 and to be completed before the fifteenth day of November, as required by chapter 90 of the Revised Laws.

Wherever inspectors examine animals and find them free from contagious disease they will give owners certificates of health, as provided for in section 18 of the law, from the book of blanks (Form No. 2) furnished for that purpose. Books will also be provided (Form No. 1) for carrying out the provisions of sections 17 and 24 of chapter 90 of the Revised Laws.

Inspectors will make a full and complete report on every place inspected, including all dimensions and measurements provided for on the blank, and answer in full all questions as to the light, ventilation, sanitary surroundings and water supply, as well as the number of cattle kept in each stable, and give complete lists of other animals in places provided for in book.

Inspectors of animals are not to quarantine any cattle as tuberculous unless they show sufficient evidence of disease to make it possible to condemn them on a physical examination. The only exception to be made is in case a milch cow shows evidence of tuberculosis of the udder; such an animal can be quarantined and the duplicate notice sent to this office.

It is also requested that, if cases of tuberculosis in animals are found, inspectors keep a record of them for a few days, and then when animals are quarantined several can be quarantined at once and duplicates sent here, so that the agent of the Cattle Bureau can see a number at one visit, instead of having to go every two or three days to see one animal at a time, thus avoiding running up expenses as much as possible.

It is also the duty of inspectors of animals to quarantine cattle brought into this State from without the limits of the Commonwealth, if the owner has not had a permit from this Bureau, the same to remain in quarantine until this office is furnished with a satisfactory certificate of tuberculin test.

Inspectors of animals are reminded that tuberculosis among cattle is not the only contagious disease with which they are called upon to deal, but in case they suspect the presence of any contagious disease among any species of domestic animals, they are to quarantine such animals and send duplicates to the Cattle Bureau office, in accordance with the provisions of section 19 of chapter 90 of the Revised Laws. Rabies is just now very prevalent in various parts of the State; and glanders and farcy is a dangerous disease, over which a constant surveillance must be exercised.

Section 28 of chapter 90 of the Revised Laws provides as follows: "Contagious diseases, under the provisions of this chapter, shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis."

As section 24 requires that the results of the inspection shall be incorporated in the annual report of the Chief of the Cattle Bureau to the State Board of Agriculture, it will be seen that it is necessary for the returns to be at this office by November 15, in order to prepare them for publication.

The necessary books for the inspection will be forwarded at once by mail. Please report immediately if not received by October 1.

AUSTIN PETERS,
Chief of Cattle Bureau.

The following table embodies a condensed report of the doings of the inspectors of animals in making the annual inspection, which complies with the requirements of section 24, chapter 90, Revised Laws: —

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC., REQUIRED BY SECTION 24, CHAPTER 90, REVISED LAWS.

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Abington,	109	356	290	94	6	85	-	97	40	19	104	119	3
Acton,	113	1,163	748	108	7	127	-	125	117	127	126	120	45
Acushnet,	143	633	443	138	-	231	3	141	111	123	127	131	2
Adams,	81	925	631	75	51	456	-	40	47	59	61	57	3
Agawam,	176	1,432	1,067	174	-	518	3	149	159	166	171	174	8
Alford,	47	313	243	46	219	122	-	34	41	45	51	48	-
Amesbury,	98	510	356	95	12	70	-	75	87	82	82	99	6
Amherst,	113	1,236	889	110	-	227	-	108	83	104	109	101	3
Andover,	144	1,393	1,058	128	3	736	4	119	110	140	140	149	13
Arlington,	75	200	181	71	-	90	-	65	69	66	75	74	2
Ashburnham,	124	581	369	83	41	199	-	118	82	95	92	93	20
Ashby,	140	874	543	137	26	158	-	133	137	137	139	139	-
Ashfield,	160	1,532	780	137	1,399	257	18	159	142	160	176	178	2
Ashland,	80	424	271	68	-	229	-	81	66	76	74	74	1
Athol,	141	770	506	120	66	263	-	124	74	79	124	132	12

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Attleborough,	182	1,101	822	177	1	1,018	–	173	169	179	174	182	4
Auburn,	66	635	460	41	–	95	–	53	48	50	46	61	18
Avon,	55	211	180	53	10	38	2	21	26	44	51	54	4
Ayer,	26	123	81	22	2	57	–	26	28	28	26	28	1
Barnstable,	232	689	484	128[1]	36	575	–	214	224	227	228	218	–
Barre,	113	2,441	1,385	102	57	292	2	116	97	120	114	121	33
Becket,	66	437	232	66	154	77	47	54	58	69	69	69	1
Bedford,	63	680	420	62	1	233	–	52	57	53	59	62	–
Belchertown,	293	2,275	1,392	269	18	419	1	290	304	313	309	317	18
Bellingham,	88	703	495	77	–	119	–	104	54	106	103	112	13
Belmont,	29	236	199	28	–	200	–	29	21	26	28	15	–
Berkley,	108	469	343	108	14	139	–	93	107	107	105	107	–
Berlin,	96	752	479	85	55	135	–	83	70	91	94	96	3
Bernardston,	85	727	408	50	147	287	–	82	42	–	51	84	1
Beverly,	52	755	619	44	–	160	–	38	46	54	52	53	4
Billerica,	139	859	603	131	1	394	2	116	132	132	118	139	6

Blackstone,	84	448	323	43	-	151	-	77	26	27	81	42	2
Blandford,	99	1,045	519	96	120	94	-	98	108	115	111	103	-
Bolton,	109	960	602	76	7	139	11	97	76	88	70	106	4
Boston,	186	1,013	896	165	-	57	-	172	137	134	136	180	9
Bourne,	76	181	123	101[1]	-	13	-	74	77	77	76	77	-
Boxborough,	50	650	354	49	19	92	22	44	48	46	49	48	1
Boxford,	60	624	381	53	9	133	-	60	49	57	59	60	-
Boylston,	65	707	444	64	-	113	1	63	63	64	61	65	1
Braintree,	83	484	407	80	2	146	2	71	80	80	81	83	1
Brewster,	91	178	118	85	67	92	-	72	31	77	82	67	1
Bridgewater,	188	735	504	183	33	244	2	178	171	175	184	188	4
Brimfield,	98	997	639	97	98	123	-	35	55	83	98	97	-
Brockton,	63	877	566	63	7	45	11	63	57	60	56	68	1
Brookfield,	129	892	559	89	25	259	-	128	105	21	108	119	1
Brookline,	50	306	233	41	-	101	-	42	33	34	39	53	-
Buckland,	125	1,074	558	99	425	225	2	97	103	58	129	156	4
Burlington,	45	489	377	43	-	3,135	-	38	45	44	43	45	4
Cambridge,	39	104	104	39	-	-	-	39	39	39	39	36	-
Canton,	126	649	455	124	66	229	-	103	111	118	121	121	1
Carlisle,	60	578	383	38	-	93	-	57	50	51	43	57	1
Carver,	91	182	133	82	14	57	-	80	82	86	80	86	1
Charlemont,	77	735	462	70	476	165	30	48	70	83	78	87	1

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Charlton,	151	1,613	937	138	76	245	5	152	145	132	139	113	5
Chatham,	70	152	118	53	-	80	4	53	21	12	59	57	2
Chelmsford,	111	906	613	105	12	192	-	120	83	121	102	123	14
Chelsea,	28	258	229	22	-	-	-	28	27	27	26	27	-
Cheshire,	122	1,215	841	116	85	352	-	90	94	101	109	107	13
Chester,	90	769	339	88	636	243	5	99	62	100	122	125	1
Chesterfield,	102	995	469	85	5	184	-	88	87	112	112	130	5
Chicopee,	83	600	419	57	-	168	-	81	55	73	67	66	10
Chilmark,	58	306	124	56	2,544	65	-	53	27	53	53	54	1
Clarksburg,	53	303	217	43	-	74	-	51	43	55	39	56	1
Clinton,	42	109	93	40	-	124	-	37	23	30	31	31	2
Cohasset,	110	291	237	46	-	111	-	29	52	7	60	60	14
Colrain,	136	1,684	853	101	543	274	-	116	92	130	130	126	2
Concord,	160	1,675	1,113	149	-	634	3	150	152	153	150	160	1
Conway,	85	1,358	677	82	711	260	-	75	70	82	82	86	1
Cottage City,	36	157	99	36	-	107	-	37	31	37	37	34	1

Cummington, . . .	94	886	439	90	80	149	32	80	75	101	107	111	-
Dalton,.	33	676	410	32	59	221	-	29	41	41	41	40	-
Dana, ...	68	314	180	67	13	75	-	71	40	64	71	72	1
Danvers, ...	65	977	787	60	1	32	-	64	67	69	70	75	-
Dartmouth, ...	206	1,951	1,414	187	133	532	10	183	169	159	194	213	23
Dedham, ...	91	537	423	84	-	454	5	75	78	76	82	93	1
Deerfield, ...	130	1,028	657	118	138	336	2	115	79	127	128	36	2
Dennis,.	81	170	121	74	-	91	-	73	67	77	75	61	-
Dighton, ...	115	461	342	113	31	121	-	112	112	114	109	114	1
Douglas, ...	109	379	279	103	1	147	-	102	66	100	87	103	1
Dover, ...	46	465	337	27	-	192	-	45	22	23	31	47	3
Dracut, ...	160	1,279	1,149	122	-	1,437	3	153	66	111	115	164	21
Dudley, ...	98	1,149	786	94	9	97	6	74	72	94	90	98	9
Dunstable, ...	67	615	337	64	18	126	1	71	65	72	70	66	3
Duxbury, ...	130	409	262	116	21	130	2	58	120	123	115	111	-
East Bridgewater, . . .	173	759	559	166	-	289	5	181	159	164	181	194	21
Eastham, ...	57	140	98	52	-	81	-	13[1]	20[1]	20[1]	19[1]	20[1]	-
Easthampton, . . .	123	815	691	92	3	239	1	100	79	81	108	107	-
East Longmeadow, . .	83	571	384	74	-	161	-	67	64	83	82	83	1
Easton, ...	184	788	590	181	7	2	-	–[2]	–[2]	–[2]	–[2]	–[2]	-
Edgartown, ...	58	261	169	56	886	222	7	31	63	61	63	63	10
Egremont, ...	88	919	696	88	149	81	1	55	94	94	93	94	3

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[1] Incomplete report.

[2] No report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Enfield, ...	89	529	344	85	46	101	5	78	78	90	85	90	10
Erving,.	41	146	99	38	177	76	-	30	31	40	41	37	-
Essex, ...	65	648	398	65	2	79	-	54	63	62	57	62	3
Everett, ...	33	209	199	29	-	352	-	34	30	30	31	29	3
Fairhaven, ...	83	623	466	74	10	155	-	82	41	70	72	81	-
Fall River, ...	94	568	436	90	-	318	-	43	86	83	73	95	1
Falmouth, ...	162	439	348	160	-	266	1	123	130	141	138	161	1
Fitchburg, ...	141	995	716	113	3	249	2	104	74	71	103	123	4
Florida, ...	68	500	275	40	32	202	-	57	23	25	22	73	10
Foxborough, ...	140	569	386	135	10	415	2	117	130	123	110	142	1
Framingham, ...	195	1,568	1,091	188	-	137	-	182	196	199	199	181	6
Franklin, ...	141	748	627	130	-	61	1	135	129	140	141	134	3
Freetown, ...	101	311	185	85	13	122	1	104	62	78	103	85	-
Gardner, ...	75	707	470	58	2	194	-	60	39	41	51	68	-
Gay Head, ...	24	89	24	24	-	22	-	3	1	1	24	24	1
Georgetown, ...	78	327	197	72	-	51	25	72	62	75	68	75	1

Gill,	71	869	487	51	160	409	–	68	49	69	66	81	4
Gloucester,	106	679	583	90	–	56	–	109	67	62	81	31	15
Goshen,	41	376	149	39	65	96	2	–[1]	–[1]	–[1]	–[1]	–[1]	–
Gosnold,	8	41	33	8	2,238	27	–	8	7	8	8	8	–
Grafton,	133	1,515	1,011	122	124	315	–	122	130	125	124	135	2
Granby,	124	1,356	1,011	124	111	159	1	141	132	139	138	142	4
Granville,	122	885	503	111	46	201	–	111	127	127	128	129	3
Great Barrington,	144	1,687	1,050	111	407	545	30	125	85	86	81	150	7
Greenfield,	148	1,251	781	133	679	373	–	134	140	141	139	148	1
Greenwich,	63	418	276	48	–	70	–	60	50	55	61	68	8
Groton,	144	1,070	641	90	91	145	16	146	112	141	99	105	2
Groveland,	65	374	247	58	53	149	–	68	52	53	50	70	4
Hadley,	205	1,807	1,017	170	176	486	–	241	153	258	257	263	5
Halifax,	67	172	121	66	9	54	1	34	67	67	67	67	–
Hamilton,	55	350	252	53	1	160	–	56	41	57	49	57	–
Hampden,	85	642	398	83	25	101	–	80	88	89	89	91	2
Hancock,	59	698	397	56	672	228	–	58	35	84	77	88	–
Hanover,	115	321	255	113	3	186	2	106	114	113	114	115	–
Hanson,	91	193	143	88	–	136	4	85	88	90	86	87	4
Hardwick,	105	2,213	1,464	98	80	316	–	104	75	100	105	105	–
Harvard,	22	1,628	917	89	46	45	–	164	127	159	117	131	6
Harwich,	127	241	179	126	6	108	11	110	109	123	125	124	1

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Hatfield,	123	379	343	118	-	191	-	121	122	122	122	123	-
Haverhill,	229	1,343	964	166	9	117	16	221	63	51	201	62	2
Hawley,	73	765	400	41	326	157	-	67	27	40	31	73	-
Heath,	81	918	405	80	235	118	2	58	92	94	93	89	-
Hingham,	154	664	473	150	-	409	2	132	150	155	156	159	1
Hinsdale,	99	844	485	93	148	162	7	55	53	55	100	102	-
Holbrook,	67	210	156	61	-	160	-	58	58	54	61	62	-
Holden,	71	675	424	53	-	151	-	69	53	58	52	69	2
Holland,	32	207	75	32	40	80	1	34	22	35	34	33	-
Holliston,	138	853	543	108	7	116	1	120	107	97	115	133	5
Holyoke,	75	820	481	61	-	252	6	62	62	81	60	43	10
Hopedale,	26	116	90	26	-	21	1	22	17	24	26	26	-
Hopkinton,	146	865	527	132	-	136	2	130	125	130	131	142	6
Hubbardston,	123	986	563	106	20	215	325	92	76	77	89	101	4
Hudson,	47	353	228	47	-	89	-	45	40	39	41	46	2
Hull,	15	62	47	15	-	4	1	6	13	13	13	-	-

Huntington,	100	750	315	87	316	166	–	84	71	113	106	115	3
Hyde Park,	19	79	68	15	–	–	–	19	11	11	16	19	–
Ipswich,	135	1,016	688	134	18	302	5	133	128	139	136	137	2
Kingston,	93	264	190	75	8	159	3	78	56	61	54	97	4
Lakeville,	92	373	226	75	13	126	–	84	68	78	59	92	2
Lancaster,	77	728	467	60	9	165	–	72	58	73	60	65	3
Lanesborough,	104	1,166	715	102	11	144	1	71	108	108	108	108	–
Lawrence,	9	83	62	8	–	27	–	8	9	9	7	9	–
Lee,	165	859	587	159	281	310	10	128	167	171	168	153	1
Leicester,	8	172	112	7	–	2	–	7	8	8	8	8	–
Lenox,	30	462	312	27	–	100	–	16	15	15	30	28	3
Leominster,	103	1,176	738	35	30	302	–	117	76	87	50	93	4
Leverett,	104	598	336	98	25	213	–	97	97	117	102	99	6
Lexington,	49	941	785	48	–	405	–	39	29	42	48	38	1
Leyden,	74	715	361	74	547	246	–	49	65	83	85	85	–
Lincoln,	80	1,030	751	74	22	650	2	65	57	68	52	81	1
Littleton,	90	1,545	893	89	1	98	10	89	89	90	90	87	–
Longmeadow,	54	324	220	53	–	406	–	49	53	58	60	63	1
Lowell,	52	363	315	47	–	186	–	40	34	43	43	49	2
Ludlow,	119	888	714	116	32	436	2	105	84	107	111	95	10
Lunenburg,	134	1,208	790	129	29	226	–	134	106	132	126	138	3
Lynn,	86	278	246	75	2	138	1	85	65	87	57	90	7

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Lynnfield, ...	27	326	272	23	-	9	-	27	26	26	25	27	-
Malden, ...	37	189	179	30	-	-	-	29	20	17	23	25	1
Manchester, ...	17	86	64	17	2	18	-	17	18	18	18	18	-
Mansfield, ...	119	430	318	77	-	225	6	50	76	80	105	113	6
Marblehead, ...	46	333	284	30	-	607	3	22	20	22	38	8	20
Marion, ...	33	135	103	27	-	159	3	18	22	20	20	31	-
Marlborough, . . .	200	1,423	931	195	27	470	7	201	196	199	191	197	11
Marshfield, ...	144	513	341	133	4	145	6	132	100	120	138	124	2
Mashpee, ...	20	32	15	19	-	51	-	19	16	19	18	19	-
Mattapoisett, . . .	100	370	237	94	-	278	32	85	86	94	98	102	-
Maynard, ...	35	241	162	29	7	90	-	27	33	30	28	33	2
Medfield, ...	66	592	394	63	-	424	-	71	70	71	71	71	4
Medford, ...	79	411	361	76	-	21	2	75	65	66	72	79	2
Medway, ...	127	577	377	120	-	79	-	105	110	114	110	126	30
Melrose, ...	35	137	117	19	-	2	-	33	16	15	14	36	4
Mendon, ...	95	602	419	84	-	88	-	98	73	72	88	102	5

Merrimac,	63	350	218	47	1	114	2	58	51	20	59	59	–
Methuen,	173	1,588	1,164	102	8	814	–	163	96	70	91	173	1
Middleborough,	322	1,007	694	303	24	494	16	312	321	319	323	324	3
Middlefield,	51	550	196	37	581	218	43	49	42	44	54	64	2
Middleton,	57	388	280	47	2	243	20	62	50	57	48	60	6
Milford,	150	492	364	142	–	305	4	133	133	133	135	147	3
Millbury,	131	1,025	675	122	–	118	51	113	112	122	125	127	6
Millis,	78	739	454	31	11	106	–	63	51	27	53	69	11
Milton,	119	823	702	118	–	267	1	99	119	118	119	119	2
Monroe,	21	163	86	21	50	39	–	18	20	22	22	22	1
Monson,	185	1,528	950	161	8	440	5	123	171	209	201	217	2
Montague,	141	832	464	115	180	342	–	120	59	76	91	117	1
Monterey,	60	596	332	46	388	202	–	27	25	45	58	59	–
Montgomery,	40	439	248	40	39	39	–	43	39	38	43	43	–
Mount Washington,	16	78	54	13	2	34	6	7	7	13	15	16	–
Nahant,	7	37	34	7	–	–	–	7	7	7	6	7	–
Nantucket,	63	563	377	56	150	101	11	45	53	63	62	46	–
Natick,	83	613	492	60	–	168	–	82	52	40	65	83	2
Needham,	102	724	556	89	19	91	1	85	50	93	80	101	1
New Ashford,	24	178	125	23	291	24	–	23	27	27	27	27	–
New Bedford,	75	550	425	74	–	100	–	72	60	65	69	71	1
New Braintree,	73	1,499	1,036	70	–	63	–	73	72	73	71	72	4

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Newbury,	117	1,548	813	105	74	310	–	108	145	182	185	142	2
Newburyport,	105	481	323	104	–	187	–	114	108	110	113	112	5
New Marlborough,	82	1,156	769	46	235	42	14	56	55	31	72	83	3
New Salem,	121	482	302	117	55	136	1	113	119	119	116	121	2
Newton,	235	1,274	1,196	227	16	111	1	204	215	225	221	245	5
Norfolk,	73	413	278	70	–	142	–	72	70	71	71	62	1
North Adams,	35	555	356	35	75	168	–	30	34	34	35	35	1
Northampton,	62	989	639	58	–	605	2	47	39	64	64	67	2
North Andover,	74	1,126	724	68	19	23	–	71	66	74	72	74	1
North Attleborough,	128	697	569	95	–	231	–	119	91	97	104	132	7
Northborough,	97	1,153	756	89	7	37	1	96	90	80	94	99	28
Northbridge,	91	563	379	84	–	308	–	86	80	90	89	90	–
North Brookfield,	137	1,190	774	119	–	112	–	124	70	47	115	129	2
Northfield,	76	657	474	74	69	123	–	72	72	74	64	75	–
North Reading,	65	555	395	63	3	–	–	60	59	65	63	61	1
Norton,	154	493	353	137	3	152	1	130	120	78	138	151	1

Norwell, ...	97	234	196	95	35	128	-	91	79	95	95	97	-
Norwood, ...	78	375	302	77	-	126	-	76	80	80	82	82	-
Oakham, ...	58	688	449	50	-	87	-	62	34	29	56	43	-
Orange, ...	189	1,119	686	173	36	448	-	187	181	192	174	205	-
Orleans, ...	85	171	133	69	37	145	-	74	60	75	64	77	1
Otis, ...	87	464	249	87	211	186	-	70	93	91	93	94	2
Oxford, ...	157	835	503	137	50	313	11	131	112	135	127	138	-
Palmer, ...	162	815	580	155	-	40	-	106	86	69	109	118	-
Paxton, ...	60	542	406	56	55	67	-	56	46	50	54	60	1
Peabody, ...	59	790	722	53	21	676	-	42	47	57	47	58	7
Pelham, ...	48	228	145	47	-	56	-	46	33	37	50	48	1
Pembroke, ...	106	216	155	104	-	156	-	105	104	105	101	102	-
Pepperell, ...	141	867	643	132	-	256	3	139	115	116	138	143	26
Peru, ...	52	425	283	44	99	73	-	4[1]	14[1]	15[1]	17[1]	17[1]	-
Petersham, ...	110	754	455	101	53	293	-	99	56	59	95	103	2
Phillipston, ...	70	481	309	67	-	146	1	67	47	64	68	77	10
Pittsfield, ...	68	1,273	855	57	107	222	1	63	42	37	47	61	2
Plainfield, ...	67	694	318	52	233	171	1	81	40	64	74	79	3
Plainville, ...	59	273	199	53	-	178	3	58	48	54	52	57	1
Plymouth, ...	170	525	376	142	20	408	14	128	99	134	134	156	6
Plympton, ...	53	211	132	46	-	39	-	53	46	38	64	46	-
Prescott, ...	62	492	269	48	-	106	-	68	62	67	57	42	1

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REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

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Princeton,	100	1,209	707	80	79	149	13	77	85	72	82	109	4
Provincetown,	12	109	69	10	–	17	–	11	9	3	11	4	3
Quincy,	99	676	602	86	5	127	8	21[1]	20[1]	20[1]	20[1]	23[1]	4
Randolph,	105	381	302	104	–	1,125	–	97	108	108	108	108	1
Raynham,	144	586	458	142	7	260	4	140	110	137	139	138	9
Reading,	76	420	335	72	6	225	–	73	75	77	78	77	–
Rehoboth,	223	1,513	1,223	210	46	533	2	212	115	134	124	219	2
Revere,	29	185	175	29	–	290	–	28	29	24	28	16	–
Richmond,	87	596	387	86	597	193	–	72	80	89	89	89	3
Rochester,	122	364	247	114	–	259	1	75	89	112	112	128	–
Rockland,	102	248	203	64	–	71	–	94	59	44	46	99	2
Rockport,	38	221	187	35	–	64	–	33	34	34	33	35	6
Rowe,	66	481	274	65	99	88	–	69	74	78	74	72	1
Rowley,	86	538	406	60	–	125	1	74	61	70	63	77	2
Royalston,	116	845	464	93	56	184	–	108	85	106	105	114	3
Russell,	47	245	116	34	82	90	–	42	16	33	23	48	2
Rutland,	102	958	560	99	–	173	–	110	77	112	97	117	9

Salem,	17	329	284	17	3	190	1	15	11	12	17	17	2
Salisbury,	100	535	310	96	2	81	–	99	100	98	99	93	2
Sandisfield,	111	986	511	110	77	180	–	90	75	118	109	119	1
Sandwich,	92	295	177	90	–	128	–	42	90	91	91	91	–
Saugus,	54	968	893	54	–	45	–	63	54	60	64	66	31
Savoy,	100	680	377	80	105	196	–	93	45	48	91	91	–
Scituate,	127	375	275	125	1	57	–	111	92	115	120	126	–
Seekonk,	147	1,283	900	125	18	3,406	7	98	91	143	124	85	3
Sharon,	76	293	232	74	2	113	–	63	68	74	73	37	–
Sheffield,	190	1,965	1,430	140	232	463	–	151	134	221	217	163	4
Shelburne,	106	1,615	695	95	792	178	–	87	97	100	104	102	4
Sherborn,	62	895	597	53	3	438	16	53	52	44	52	59	15
Shirley,	59	364	267	58	13	83	–	65	60	61	65	65	–
Shrewsbury,	127	1,598	994	106	5	472	2	113	107	102	112	116	5
Shutesbury,	33	143	90	33	–	54	–	29	34	34	34	34	–
Somerset,	90	629	507	89	12	652	–	77	79	89	87	58	3
Somerville,	36	118	105	27	–	112	3	35	19	20	26	36	23
Southampton,	139	1,234	694	137	73	389	–	5[1]	6[1]	6[1]	6[1]	6[1]	2
Southborough,	105	1,126	899	89	–	135	–	110	100	61	97	113	10
Southbridge,	100	714	425	90	24	272	–	86	48	63	67	90	9
South Hadley,	111	1,242	955	74	–	340	4	120	100	87	100	126	1
Southwick,	125	975	646	122	327	267	29	117	108	127	125	128	1

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[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Continued.*

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Spencer,	146	1,542	882	137	15	366	15	98	148	151	138	150	–
Springfield,	132	540	397	97	14	1,087	1	78	61	108	108	81	–
Sterling,	141	1,834	1,188	116	214	184	–	128	–[1]	–[1]	1[1]	3[1]	1
Stockbridge,	100	772	473	85	306	249	5	61	69	96	85	103	3
Stoneham,	88	329	280	69	74	386	1	43	29	23	64	69	15
Stoughton,	130	466	345	108	–	56	8	115	80	102	95	125	1
Stow,	97	940	555	24	–	124	1	108	52	56	31	95	1
Sturbridge,	22	185	125	20	4	70	–	22	21	22	22	22	1
Sudbury,	94	1,245	842	87	–	247	2	33	88	90	89	93	–
Sunderland,	82	779	482	35	–	436	–	41[1]	24[1]	18[1]	13[1]	44[1]	5
Sutton,	168	1,400	883	104	129	255	5	95[1]	76[1]	40[1]	101[1]	135[1]	10
Swampscott,	25	119	101	22	–	10	–	20	23	24	24	24	2
Swansea,	134	1,089	782	133	4	435	–	133	138	138	138	137	–
Taunton,	150	941	788	150	12	347	1	132	150	150	150	150	–
Templeton,	129	698	416	122	6	177	1	79	103	130	122	132	2
Tewksbury,	108	741	514	101	3	710	2	106	79	90	96	109	13
Tisbury,	25	71	56	24	3	43	–	9	15	15	22	25	6

Tolland, ...	38	459	246	36	–	98	–	32	26	33	34	26	2
Topsfield, ...	76	673	455	58	–	57	2	68	57	62	59	67	20
Townsend, ...	135	539	350	121	1	340	–	132	123	125	127	133	2
Truro, ...	64	238	179	64	–	49	–	5	64	64	63	64	3
Tyngsborough, . . .	57	398	270	21	22	236	–	26	17	29	27	35	4
Tyringham, ...	53	518	287	50	193	194	–	53	43	52	51	51	1
Upton, ...	103	639	419	33	–	421	–	88	83	64	78	99	10
Uxbridge, ...	139	867	585	135	47	241	84	142	135	143	143	136	10
Wakefield, ...	71	352	299	61	2	828	4	64	73	73	70	75	3
Wales, ...	48	230	138	7	76	61	–	43	33	45	50	28	2
Walpole, ...	113	518	399	109	–	646	1	78	63	61	37	92	1
Waltham, ...	32	637	507	26	–	831	–	32	24	24	25	30	1
Ware, ...	120	957	623	109	3	246	10	111	110	113	116	120	4
Wareham, ...	74	235	198	65	28	119	6	65	65	64	64	66	–
Warren, ...	128	1,934	1,036	124	26	260	–	129	102	11	127	120	9
Warwick, ...	69	330	206	60	24	81	–	64	67	69	72	70	–
Washington, ...	51	620	297	44	543	205	1	22	33	57	55	59	–
Watertown, ...	57	288	259	55	4	459	–	36	33	41	53	60	5
Wayland, ...	69	850	604	69	–	703	–	61	59	62	70	59	1
Webster, ...	32	249	190	29	–	21	–	31	26	27	30	31	3
Wellesley, ...	69	289	241	67	–	–	–	64	36	63	63	68	–

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[1] Incomplete report.

REPORT OF INSPECTION OF ANIMALS, STABLES, ETC. — *Concluded.*

CITY OR TOWN.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Goats inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.
Wellfleet,	35	83	51	33	2	20	–	28	32	32	34	34	1
Wendell,	64	259	123	62	21	168	2	29	47	49	63	63	4
Wenham,	54	317	280	49	–	159	3	49	44	39	46	51	–
Westborough,	147	1,863	1,157	134	5	723	7	132	121	132	131	146	4
West Boylston,	85	907	607	70	5	392	–	94	95	102	102	101	57
West Bridgewater,	50	798	584	46	10	78	6	3[1]	48	46	48	51	–
West Brookfield,	100	1,446	736	55	45	332	21	82	31	48	92	99	9
Westfield,	206	1,468	894	205	7	636	–	201	225	225	224	224	2
Westford,	116	1,091	676	99	–	294	–	118	107	116	88	125	8
Westhampton,	66	581	325	47	1	121	–	49	30	60	47	61	2
Westminster,	86	648	469	79	40	15	–	82	56	3[1]	85	7[1]	7
West Newbury,	135	1,128	645	101	30	338	12	128	109	124	98	6	13
Weston,	115	993	732	107	37	396	–	110	115	111	103	123	11
Westport,	300	1,548	1,106	285	20	357	–	275	178	236	267	273	11
West Springfield,	128	855	607	127	1	550	–	125	116	113	125	126	1
West Stockbridge,	112	535	378	112	314	204	–	78	105	108	110	112	3
West Tisbury,	55	232	164	54	1,018	72	2	24	56	56	56	56	–

Westwood, ...	60	543	460	59	-	769	46	44	63	63	63	64	-
Weymouth, ...	174	749	604	106	-	317	12	135	86	82	84	161	3
Whately, ...	107	869	512	107	6	217	-	100	118	127	128	131	4
Whitman, ...	88	418	345	86	20	200	-	80	65	65	77	85	4
Wilbraham, ...	111	854	469	107	-	207	-	92	96	93	95	112	1
Williamsburg, . . .	101	804	414	75	45	100	-	90	53	70	82	86	-
Williamstown, . . .	185	1,619	1,023	132	1,868	555	1	165	104	78	155	184	10
Wilmington, ...	94	316	205	84	1	431	15	86	60	80	72	94	21
Winchendon, . . .	147	710	527	139	52	362	-	142	142	148	139	150	29
Winchester, ...	41	210	204	39	-	38	6	32	34	30	34	41	-
Windsor, ...	90	960	489	86	72	274	5	87	106	113	115	102	4
Winthrop, ...	12	39	33	12	-	-	-	4	12	12	12	12	-
Woburn, ...	68	277	236	53	-	191	2	8[1]	51	49	29	67	3
Worcester, ...	307	2,239	1,820	303	43	4,539	6	300	303	301	305	307	6
Worthington, . . .	101	970	531	96	111	221	-	88	88	105	104	105	1
Wrentham, ...	100	296	222	65	-	105	-	94	45	16	48	65	6
Yarmouth, ...	50	129	102	48	28	102	-	39	45	45	48	48	1
	33,715	247,288	164,396	29,584	28,799	78,371	1,417	29,120	26,334	28,420	30,053	31,804	1,424

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[1] Incomplete report.

There is little comment to be made on the table, further than to note that the number of sheep seems to have increased over the number reported the previous year. In spite of the obstacles to this industry, there seems to be quite a little interest taken in it at the present time.

TUBERCULOSIS.

That portion of the duties of the Cattle Bureau in connection with tuberculosis can be divided, as in preceding years, under three heads.

First. — That part of the work resulting from the action of the local inspectors of animals quarantining cattle suspected of having tuberculosis, which must be examined by agents of the Cattle Bureau, and appraised and killed if found to be diseased, or released from quarantine if the agents do not consider them diseased.

Second. — The quarantine work required by the regulations of the Cattle Bureau, intended to prevent the introduction of tuberculous animals from without the State, all neat cattle except beeves for immediate slaughter, calves under six months old, cattle returning from out-of-State pastures, or cattle intended for exhibition at cattle shows, being subjected to a tuberculin test.

This can be sub-divided into testing all cattle brought to the stock yards at Brighton, Watertown or Somerville upon which a tuberculin test is required, and bringing cattle to points outside these yards, which are held as quarantine stations, upon permits issued by the Chief of the Cattle Bureau.

The quarantine stations are in charge of Mr. C. A. Dennen, and here the milch cows, store cattle, bulls and working oxen are tested every Tuesday night and Wednesday morning, coming from other States, which are to be offered for sale on the market Wednesday morning. Here no certificates of test made outside the State are accepted; every animal upon which a test is required is tested by the agent and his assistants.

In regard to the other portion of this work, consisting of testing cattle brought on permits to points outside the quarantine stations, if these animals are accompanied by a satisfactory certificate of tuberculin test, no further test is required; if not, they are tested free of charge to citizens of Massachusetts, and at cost for other persons, but at the owners' risk.

Third. — Testing entire herds at the request of the owners, with a view to eradicating tuberculosis from them. This is known as "voluntary request work." Nearly twice the number of cattle and herds have been tested for owners under this head that were tested during the previous year, and more could be done in this line if the appropriations of the Cattle Bureau permitted of it.

The following figures show what has been done under each division: —

Massachusetts Cattle.

Number released,	743	
Number condemned, killed and paid for,	1,120	
Number permit to kill, and paid for,	82	
Number permit to kill, no award,	152	
Number died in quarantine, no award,	66	
Number condemned and killed in process of settlement,	579	
Number released for lack of funds,	6	
Total Massachusetts cattle quarantined,		2,748

Cattle from without the State.

Number released,	159	
Number condemned and killed, no award,	268	
Number killed at owner's request after first test, no award,	9	
Number died in quarantine, no award,	2	
Number brought into State on approved test, retested and condemned (4 of which have been paid for, 1 in process of settlement),	5	
Number condemned, killed, no lesions found (4 of which have been paid for, 4 in process of settlement),	8	
Total, including 337 Brighton cattle held for retest,		451
Total number cattle quarantined,		3,199

Among the Massachusetts cattle quarantined, 25 were tested to satisfy the owners as to the presence or absence of disease; of these, 13 were condemned and killed and 12 were released.

Of the 281 condemned and killed on suspicion of being tuberculous, brought into Massachusetts from without the State, 192 were tested and retested at Brighton, and the remaining 89 were tested at other places. Eight were found to show no lesions of tuberculosis, for which the State reimburses owners. Of these 8, 2 were tested at Brighton and 6 at other points.

Of the animals tested and retested at Brighton and condemned, 81 were rendered and 102 passed for beef.

During the year 377 cattle and 21 swine were reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter. These animals were not quarantined, and are not included in the 3,199 above reported.

Receipts of Stock at the Watertown Stock Yards, from Dec. 16, 1905, to Nov. 30, 1906.

Vermont cattle,	5,221
New Hampshire cattle,	5,014
New York cattle,	826
Massachusetts cattle,	2,674
Western cattle,	18,403
Sheep,	4,784
Swine,	6,929
Calves,	28,074

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, from Dec. 16, 1905, to Nov. 30, 1906.

Maine cattle,	2,928
New Hampshire cattle,	1,793
Vermont cattle,	4,583
Massachusetts cattle,	989
Western cattle,	81,526
Sheep,	314,063
Swine,	1,064,982
Calves,	63,061

Cattle not for immediate slaughter have been tested by the agent of the Cattle Bureau at Brighton, and are included in the Brighton report.

Receipts of Stock at Brighton, from Dec. 16, 1905, to Nov. 30, 1906.

Maine cattle,	9,110
New Hampshire cattle,	1,711
Vermont cattle,	1,908
New York cattle,	909
Massachusetts cattle,	14,354
Western cattle,	48,151
Sheep,	18,139
Swine,	18,574
Calves,	51,452
Cattle tested,	13,262
Cattle condemned after test,	178
Cattle killed on permit to kill,	15
Cattle released after test,	13,069

Report of Cattle brought into State during the Year, to Points outside of the Quarantine Stations.

For dairy and breeding purposes, tested before shipment,	2,959
For dairy and breeding purposes, tested after arrival,	4,065
For dairy and breeding purposes, awaiting test,	1
	7,025
Neat cattle on which no test was required,	5,434
Total,	12,459

The cattle and calves on which no test was required were as follows: —

Returned from out-of-State pastures,		847
Calves under six months old,		315
Killed by accident before test could be made,		1
Died before test could be made,		1
Condemned on physical examination and killed,		1
Pastured in State for brief period only,		5
Unloaded in transit through State,		34
Cattle for immediate slaughter,	1,746	
Calves for immediate slaughter,	2,484	
		4,230
Total,		5,434

Nearly all of these cattle were brought in on permits issued by the Chief of the Cattle Bureau, only 448 head having been brought in without permits, which were reported to this Bureau by railroad agents, local inspectors or others.

Of these, 11 were accompanied by satisfactory certificates of tuberculin test, 14 were calves under six months old, 11 were slaughtered at once for beef, 22 were returned from pasture, 1 was condemned on physical examination and killed, 1 was killed by accident before test could be made, 16 were unloaded in border town in transit through the State, 2 were pastured in the State for a short period only, and the remainder, 370 head, were tested by agents of the Cattle Bureau.

There were 892 permits issued, 114 of which were not used; on the balance, 12,011 head of cattle were brought into the State.

Twenty-three permits were issued allowing cattle to be brought into the State for exhibition at agricultural fairs, to remain for a short time only, 1 of which was not used; 9 were issued for bringing cattle back from exhibition in other States, 2 of which were not used. Four permits were issued for pasturing cattle in this State for the season, 1 permit was given for returning cattle daily from a pasture in Connecticut, 1 allowing a large bull to be exhibited at a museum during the season, and 1 allowing an owner who lived near the New Hampshire line to bring Massachusetts cattle back into the State after being loaded at a station in New Hampshire, simply as a matter of convenience.

The third portion of this work, or "voluntary request work," is shown in the appended list: —

Number of herds tested,		16
Number of animals tested,		400
Number condemned and rendered,	63	
Number condemned and passed for beef, no award,	43	
Number released,	294	
		400

Of the animals killed, 2 were found not diseased, but the owner would not accept payment therefor.

Two instances have occurred during the past year of owners of cattle, quarantined as having tuberculosis, breaking quarantine.

One was at Gloucester last October, where the owner, a Finn, killed a cow that had been quarantined by the local inspector on suspicion of having tuberculosis, before an agent of the Cattle Bureau could see her, dressing the carcass off for beef and putting it in the beef barrel. In this case the local inspector was also the agent of the Cattle Bureau. When the case came to trial, the court decided to dismiss it, as the man was a foreigner with very little knowledge of English, and it did not appear that the defendant understood the nature of the quarantine imposed, and therefore he was given the benefit of the doubt, and was discharged.

The other case occurred in Quincy, where the owner of the cow quarantined, also a Finn, sold her to a Jewish cow dealer. This case came up in the district court in Quincy December 28, when the owner was fined $10. The evidence showed that the owner told the cow dealer that the cow was in quarantine, but the latter said that it did not amount to anything, that the cow was sick, and a danger to the other cows in the barn, and that he, the cow dealer, would explain it to the doctor and fix it all right. The cow dealer was summoned to appear in court Jan. 4, 1907, and was found guilty of removing an animal from quarantine, and also found guilty of removing an animal knowing or having reasonable cause to believe that it was affected with a contagious disease. The defendant was fined $75 on the first complaint and $25 on the second. He appealed, and was put under bonds for trial at the Superior Court in Dedham, later.

A little work is being done in several herds in the State in immunizing young cattle from tuberculosis by the Von Behring method. A few calves have been experimented upon in a large herd in the western part of the State by the Cattle Bureau; there are also several cattle owners who are having calves immunized in herds where tuberculosis has been troublesome during the past few years. As yet it is too early to report results; but as far as the experiments have been carried, they seem to be successful.

During the last two or three years a monthly report has been sent to the United States Department of Commerce and Labor, giving a list of the receipts of cattle, calves, sheep, lambs, swine and horses at Boston. The following table shows the animals received during the eleven months ending Nov. 30, 1906. These figures include the cattle and sheep intended for export, as well as those to be slaughtered at the abattoirs around Boston, and the milch cows for sale to farmers. Boston is quite a distributing point for horses that are sold at the sales stables to go into cities and towns surrounding Boston, as well as into some of the other New England States.

Receipts of Live Stock at Boston during Eleven Months ending Nov. 30, 1906.

For Month ending —	Cattle.	Calves.	Sheep and Lambs.	Swine.	Horses.
Jan. 30, ...	22,101	10,194	23,307	120,320	2,017
Feb. 28, ...	17,133	9,159	24,466	114,476	2,047
March 26, ...	15,486	10,363	20,400	115,086	1,913
April 25, ...	12,929	15,923	23,577	98,582	2,449
May 31, ...	16,179	19,906	27,332	93,303	3,280
June 27, ...	14,575	14,987	27,016	77,821	2,385
July 30, ...	17,519	14,052	26,284	107,761	2,701
Aug. 28, ...	14,473	12,025	18,042	78,088	2,164
Sept. 26, ...	16,271	12,044	38,176	79,915	2,140
Oct. 31, ...	17,230	15,577	50,109	100,066	2,555
Nov. 27, ...	14,248	10,908	38,048	85,877	1,940
Totals, ...	178,144	145,138	316,757	1,071,295	25,591

MISCELLANEOUS DISEASES.

During the year there have been a number of outbreaks or cases of diseases of various kinds that may be classed as miscellaneous, including hog cholera, symptomatic anthrax, anthrax, actinomycosis and other troubles similar to those brought to the attention of the Chief of the Cattle Bureau each year, and which have been described more extensively in previous reports, and measures recommended for their suppression.

About thirty outbreaks of disease have been reported among swine during the past year, many quarantined under the generic term of hog cholera. Most of them seem to have been less serious than usual, and have not involved a very large number of animals. Two lots of swine quarantined in Ashfield last March were found to be suffering from rickets when examined by Dr. J. B. Paige, due to improper feeding, the food having a deficiency of bone-forming material.

In one lot of pigs, quarantined as having hog cholera, several cases of true mange were found. There have also been three or four cases of tuberculosis reported in swine.

Several cattle have been quarantined as having actinomycosis. Most of them have been released, with the advice to the owners to fatten them and have them killed, subject to slaughterhouse inspection; two were ordered killed, as it seemed for the public interest to have them destroyed.

There have been several outbreaks of symptomatic anthrax, or "blackleg," in Worcester County and places to the westward. In most of these outbreaks an agent of the Cattle Bureau has inoculated the surviving young cattle with "blacklegoids," with good results in every instance.

On February 14 it was reported by Dr. J. N. Murray of Littleton that a farmer in Harvard had lost a cow, and previously he had lost three cows and two horses suddenly since the first of the year. He sent specimens from the fourth cow which died to Dr. Frothingham for examination, who found anthrax bacilli in them, and reported the case to be true anthrax. Dr. Madison Bunker was sent to investigate the matter, and since then no further trouble has been reported.

There have been no cases of Texas fever during 1906, but on July 12 it was reported by the agent of the United States Bureau of Animal Industry at Boston, Dr. J. F. Ryder, that a carload of cattle had been unloaded for rest and feeding at the stock yard of the Boston & Albany Railroad at West Springfield, from a car marked quarantine, and that the cattle had ticks on them. Dr. B. D. Pierce of Springfield, an agent of the Cattle Bureau, was immediately notified to see that the yard was not used again until it was properly cleansed and disinfected. This was done, and no bad results followed this incident. An account of it is given, as it illustrates that eternal vigilance is the price of health among our live stock.

On August 2 Dr. Bickell of Haverhill reported a herd of cattle that the owner feared was infected with mange, but upon investigation the trouble was found to be a bad form of ringworm.

Last April two outbreaks of dysentery were reported in herds of cattle in Sudbury and in Warren, but investigation showed that these could hardly be looked upon as contagious disease, but due to some local condition in each instance.

On October 9 a large cattle owner in Lincoln reported finding eleven cows dead that morning in one of his barns; he feared that either some contagious disease had broken out, or that they had been poisoned by some malicious person. An investigation by the Chief of the Cattle Bureau and Dr. Howard P. Rogers was made at once. It was found that the deaths occurred on the side of the barn where the dry cows were kept. There were forty cows on each side of a wide feeding floor. The eleven that died were on one side of the barn, and were scattered about at random, and did not all stand next to each other. These cows were all forward springers, and were among the best in the barn. It was thought that death resulted from acute indigestion, resulting from being fed on millet that was frost-bitten and wilted. The fact that the best cows died is accounted for by the fact that the heaviest milkers are as a rule the heaviest feeders. The cows on the other side of the barn were milkers, and did not receive any of this millet, and on that side of the aisle there was no trouble.

The last of July and early in August a number of young cattle died in a pasture in Ludlow, belonging to different owners, of a disease resembling hæmorrhagic septicæmia. Autopsies were made by the Chief of Cattle Bureau and Dr. B. D. Pierce.

There has not been any disease among sheep reported the past year. There seem to be in Massachusetts three great obstacles to successful sheep husbandry: one is dogs, another is poor fences, and the third is intestinal parasites. Stricter legislation will remedy the dog evil, more capital invested in sheep farming will obviate poor fences and a better knowledge of sheep and their diseases will result in more intelligent care and management.

Financial Statement.

Balance of appropriation for salaries and expenses for 1905, Dec. 15, 1905,		$828 12
Balance of appropriation for general work of Bureau for 1905, Dec. 15, 1905,	$2,800 88	
Deficiency appropriation under chapter 62, Acts of 1906,	11,560 24	
Total available for accounts of 1905,		14,361 12
Appropriation for salaries and expenses for eleven months, ending Nov. 30, 1906, under chapter 60, Acts of 1906,		6,416 66
Appropriation for general work of Bureau for eleven months, ending Nov. 30, 1906, under chapter 46, Acts of 1906,		60,000 00
Total to be accounted for,		$81,605 90
Expenditures during eleven months, ending Nov. 30, 1906: —		
For 531 head of cattle condemned and killed in 1905, paid for during the year 1906,	$10,910 45	
For 1,206 head of cattle condemned, killed and paid for in 1906,	25,042 30	
For expenses of arbitration, quarantine, killing and burial,	81 35	
For salary of Chief of Bureau,	1,800 00	
For expenses of Chief of Bureau,	99 93	
For salary of clerk,	1,200 00	
For assistant clerks and stenographers,	1,580 00	
For office expenses, postage, printing, etc.,	1,306 79	
For services of agents (exclusive of glanders work),	9,447 26	
For expenses of agents (exclusive of glanders work),	4,201 31	
For expenses of quarantine stations,	5,795 32	
For expenses of glanders work, including services and expenses of agents, laboratory work, and killing and burial,	5,786 63	
For laboratory and experimental work (exclusive of glanders work),	1,723 20	
For implements, ear tags, tuberculin, etc.,	874 91	
Total expenditures,		69,849 45
Balance from all accounts, Nov. 30, 1906,		$11,756 45

This amount is made up of the following items: —

Balance of salary and expense account of 1905,	$366 95	
Balance of deficit appropriation for account of 1905,	968 05	
Balance of salary and expense account for 1906,	892 84	
Balance of appropriation for general work and available for unsettled accounts of 1906,	9,528 61	
Total as above,		$11,756 45

From the sale of hides and carcasses of condemned animals, sale of ear tags, testing cattle at Brighton for non-resident owners, sale of waste paper, etc., there has been received and paid into the State treasury,	$3,883 97
The average price paid for condemned cattle during the year was	20 70

Under chapter 220, Acts of 1903, twenty-eight stamps for the use of inspectors of meats and provisions have been furnished to the boards of health of twenty-six cities and towns.

It will be seen by the foregoing statement that Nov. 30, 1906, between $9,000 and $10,000 remained of the appropriation for the general work of the Cattle Bureau for the year ending that date; when bills due for services of agents and claims for condemned cattle are all in, this amount will not be sufficient to settle them all, and it is estimated that there will be a deficiency this year of from $5,000 to $6,000.

Estimates made to the Auditor under the requirements of chapter 211, Acts of 1905, for the fiscal year ending Nov. 30, 1907, are for $82,000, divided into $7,000 for the salary of the Chief of the Cattle Bureau, his clerk, extra clerical assistance, printing, postage and general office and incidental expenses, and $75,000 for the general outside work in exterminating contagious diseases among horses and other animals.

The estimate of $7,000 is based on the same figures as the last few years; the estimate for the general expenses of the Cattle Bureau in connection with the extirpation and control of contagious animal diseases is in excess of the appropriations of the last two years, and is based on the fact that an insufficient amount is appropriated each year, and the Legislature has to make a deficiency appropriation each winter.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

SIXTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1907.

DAIRY BUREAU — 1906.

CARLTON D. RICHARDSON, WEST BROOKFIELD, *Chairman.*
JOHN M. DANFORTH, LYNNFIELD CENTRE.
HENRY E. PAIGE, AMHERST.

Secretary.
J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.
P. M. HARWOOD.
ADDRESS, ROOM 136, STATE HOUSE, BOSTON.

REPORT.

By act of the Legislature of 1905 a new fiscal year for State departments was established, beginning Dec. 1, 1906, therefore this report covers only eleven months, — Jan. 1 to Dec. 1, 1906. Hereafter reports will cover twelve months, from December 1, annually.

This year we have had occasion to bring a total of 113 cases in court, against 155 last year, 168 in 1904 and 289 in 1903, notwithstanding increased and thorough inspection. Therefore, we note a reduced tendency to violate the dairy laws. The number of oleomargarine licenses has fallen off from that reported in previous years; but, as we have brought cases under a wider range of statute violations, the number of prosecutions has increased.

It is a pleasure to be able to announce that the year has been one of general improvement along lines of sanitary milk production, especially as regards general market milk; and due credit for this should be given to the State Board of Health for its inspection of dairies, to the farmers who have responded to the suggestions made, and to the improved plants and methods of the Boston milk contractors. A beginning has been made by interested parties during the year in the matter of certified milk. What the result of this movement will be it is yet too early to determine.

This Bureau has worked unceasingly for a better dairy product, and the calls for lectures along this line have greatly increased over any previous year. We believe that fundamentally the farmers should reform their own conditions, and that it is largely due to their failure to do so that inspection and regulation become necessary. The chairman of the Bureau has responded to fifteen and the general agent to forty-five different calls within the State. Expert dairy work has been done at various fairs and other places during the year. The Bureau has also inspected many of the creameries and milk depots throughout the State.

After a careful review of the dairy situation, we believe that the Massachusetts dairymen, a majority of whom are producers of market milk, should unite in a State organization for self-education and betterment. The lack of such organization, faith in one another and general tone and confidence is to a large degree responsible for present conditions. To be sure, we have the Massachusetts Creamery Association, the Massachusetts Cattle Owners Association, etc.; but a State organization of broader scope is needed, one open to membership for all dairymen in the State, holding annual meetings and institutes to be addressed by the best experts this or any country affords, where butter and cheese may be exhibited and scored in various classes and suitable prizes awarded, where milk and cream produced under different conditions may be entered for competition for prizes for flavor, cleanliness, keeping quality, etc., where the most improved dairy machinery and methods can be exhibited and demonstrated, and where leading questions of the hour can be discussed, — to the end that Massachusetts dairymen may become united, better informed, more enthusiastic and more successful.

The personnel of the Bureau has remained the same as in previous years. H. E. Paige has been reappointed by Governor Guild, C. D. Richardson has continued as chairman, J. Lewis Ellsworth as secretary, P. M. Harwood as general agent, A. W. Lombard as agent, B. F. Davenport as chemist, and eight others have been temporarily employed during some part of the year.

The summary of the year's work is as follows: —

Total number of inspections,	[1] 5,628
Number of inspections where no sample was taken,	4,985
Number of samples of butter and oleomargarine, nearly all purchased,	583
Number of samples of milk and cream, mostly purchased,	65
Cases in court,	113
Meetings addressed by the chairman of the Bureau,	15
Meetings addressed by the general agent,	45

Cases prosecuted during the eleven months ending Nov. 30, 1906, by months and courts, with law violated, and results, are as follows: —

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Holyoke,	January,	6	Renovated butter,	6	–
Fall River,	January,	8	Renovated butter,	8	–
Fall River,	January,	3	Oleomargarine,	3	–
Quincy,	January,	8	Renovated butter,	8	–
Lawrence,	January,	2	Renovated butter,	2	–
Walpole,	January,	2	Renovated butter,	2	–
Worcester,	February,	6	Renovated butter,	6	–
Attleborough,	February,	2	Renovated butter,	–	2
Amesbury,	March,	4	Renovated butter,	4	–
Lowell,	March,	10	Oleomargarine,	10	–
Newburyport,	March,	2	Renovated butter,	2	–
Gloucester,	March,	2	Renovated butter,	2	–
Boston,[2]	March,	2	Renovated butter,	2	–
Charlestown,	March,	1	Renovated butter,	1	–
Holyoke,	April,	2	Renovated butter,	2	–
Haverhill,	April,	2	Renovated butter,	2	–

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[1] Five extra samples were taken during inspections, therefore this total is five less than the sum of the next three items.

[2] In connection with Milk Inspector Jordan of Boston.

COURT.	Month.	Number.	Law violated.	Convicted.	Discharged.
Hyde Park, .	April, .	2	Renovated butter, .	2	–
Amesbury, .	April, .	1	Oleomargarine, .	1	–
Newburyport, .	April, .	2	Oleomargarine, .	2	–
Fall River, .	May, . .	14	Oleomargarine, .	14	–
New Bedford, .	May, . .	6	Renovated butter, .	8	–
New Bedford, .	May, . .	2	Oleomargarine, .	2	–
Somerville, .	June, . .	3	Oleomargarine, .	3	–
Worcester, .	July, . .	4	Oleomargarine, .	3	1
Southbridge,[1] .	August, .	1	Oleomargarine, .	1	–
Waltham, .	August, .	3	Oleomargarine, .	3	–
Chelsea, . .	October, .	7	Milk, . . .	7	–
Grafton,[2] . .	November, .	1	Milk, . . .	1	–
Lowell, . .	November, .	5	Oleomargarine, .	5	–
Totals, .	. . .	113	. . . .	110	3

[1] In connection with Deputy Sheriff Jacobs of Southbridge.
[2] In connection with Milk Inspector Berg of Worcester.

The charges in the several cases in court for the eleven months ending Nov. 30, 1906, have been as follows: —

Selling renovated butter in unmarked packages, . . .	57
Oleomargarine in imitation of yellow butter, ...	13
Oleomargarine sold as butter, ...	2
Oleomargarine sold in unstamped wrappers, ...	2
Oleomargarine: stores without posted signs, ...	13
Oleomargarine: stores without placard on exposed contents, .	8
Oleomargarine: peddling without signs on wagons, . . .	3
Oleomargarine sold in restaurants without notice, . . .	7
Milk below standard, ...	5
Milk containing boron preservative, ...	3
Total, ...	113

The following is a list of inspections without samples and the number of samples taken in the years 1900–1906, inclusive: —

YEAR.	Inspections without Samples.	Samples taken.
1900,	1,612	826
1901,	1,757	911
1902,	3,895	1,078
1903,	4,135	1,395
1904,	4,456	1,157
1905,	4,887	971
1906,	4,985	576
Totals,	25,727	6,914
Averages,	3,675+	987+

The following is a list of the number of cases entered in court and also the number of convictions secured in the years 1900–1906, inclusive: —

YEAR.	Total Cases.	Convictions.
1900,	178	144
1901,	252	218
1902,	285	238
1903,	289	272
1904,	168	166
1905,	155	155
1906,	113	110
Totals,	1,440	1,303
Average convictions,	–	186+

OLEOMARGARINE.

The effect of the national law, and its enforcement, on the oleomargarine output of the United States, is graphically set forth by the following figures: under the old law, for the year ending June 30, 1902, the output was 126,316,472 pounds; while under the new law, for the year ending June 30, 1903, it was 71,804,102 pounds; for that ending June 30, 1904, it was 48,071,480 pounds; for that ending June 30, 1905, it was 49,880,982 pounds and for that ending June 30, 1906, it was 53,146,659 pounds.

In 1903 there were in Massachusetts 24 licenses to sell colored oleomargarine, while in 1906 there was but 1 such license, and the parties taking out that license have apparently given up attempts to use it. In 1904 there were 326 licenses issued for the sale of uncolored oleomargarine, while at the same date in 1906 there were but 90 such licenses issued. In Boston the oleomargarine receipts were 16,494 packages, as against 22,808 packages in 1905. This department has had in court during the year 48 cases for violations of oleo laws, as will be seen by the tabulated statement elsewhere given.

At the present writing, with the price of butter unusually high, there appears a prospect of increased activity in the oleo business.

RENOVATED BUTTER.

The renovated butter trade shows an increased disposition to comply with the law. In 1900 the number of violations of law prosecuted was 226; in 1904, 73; in 1905, 118; while in 1906, for eleven months, the number was 57. Secretary Wilson of the national department reports an improvement in the sanitary condition of the renovated butter factories of the United States. Two firms took out licenses early in the year to make renovated butter in this State; later, one of these, the American Farm Products Company, gave up the manufacturing business here, they having several factories in other States, and established a distributing house instead; the other, the Eastern Butter Company, continues, the only local factory now in operation.

The output of the renovated butter factories of the United

States, according to the Secretary of Agriculture, for the year ending June 30, 1906, was 53,795,321 pounds, as compared with 60,164,783 pounds for 1905, — a decrease of 6,369,462 pounds.

BUTTER.

The production of a strictly high-class butter, simple as it seems, is an extremely difficult problem, requiring knowledge, care, skill and perseverance. One man thinks he makes as good butter as another; but when two or more makes are compared, the difference becomes manifest. In examining butters of various exhibits at dairy conventions, fairs, etc., the writer has been struck with the fact that even where all are good, perhaps scoring above 90 per cent, not more than one in ten will go over 95 per cent. There can be little doubt that there is much yet to be learned, or, if not learned, to be put in practice, by the dairymen and butter makers. More attention must be given to the care of cream; possibly a local inspection of the dairies, such as is made where milk is produced for market, will become necessary, — not, however, if every patron learns how to care for his milk and cream, and then puts his knowledge in practice. This is not offered in a spirit of criticism, but is rather a hint as to what is necessary to make gilt-edged butter.

The butter market for the year has been in some respects unique. It will be noted, by reference to the appended tables, that an unusually large stock was carried over in Boston from last year, and that this was followed by an increase the first five months, after which there was a falling off in the supply from the corresponding months of the previous year. This, occurring in the face of an increased demand, caused an advance in price during the summer, which has continually increased up to the close of the year, at which time butter is selling at a higher price than any corresponding period for many years. The average is practically the same, however, as in 1905, when the price was at its maximum height in the early part of the year.

The following table shows the average quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last eight years: —

	1906. Cents.	1905. Cents.	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.
January,	25.2	28.0	22.7	28.0	25.0	25.0	29.5	21.0
February,	25.2	31.6	24.6	27.0	28.5	25.0	26.0	24.0
March,	25.5	28.0	24.1	27.0	29.0	23.0	27.0	22.5
April,	22.2	29.1	21.6	27.5	32.0	22.0	21.0	21.0
May,	19.9	23.9	19.9	22.5	25.0	19.5	20.5	19.0
June,	20.2	20.7	18.4	22.75	23.5	20.0	20.5	19.0
July,	21.0	20.6	18.3	20.5	22.5	20.0	20.5	19.0
August,	23.8	21.6	19.1	20.0	21.5	21.0	22.0	21.5
September,	25.6	21.2	20.8	22.0	23.5	22.0	22.5	23.5
October,	26.9	22.1	21.5	22.5	24.5	21.5	22.0	24.0
November,	27.6	23.0	24.1	23.5	27.0	24.0	25.0	26.5
December,	30.7	23.9	25.7	24.5	28.5	24.5	25.5	28.0
Averages,	24.48	24.47	21.73	26.23	25.0	22.3	23.5	22.4

The Chamber of Commerce figures regarding the butter business in Boston for 1905 and 1906 are as follows: —

	1906. Pounds.	1905. Pounds.
Carried over,	10,189,575	5,612,592
Receipts for January,	3,530,291	2,097,952
Receipts for February,	2,848,633	2,015,265
Receipts for March,	3,367,031	2,698,064
Receipts for April,	2,427,304	2,393,951
Receipts for May,	5,856,768	5,260,758
Receipts for June,	8,603,945	10,696,890
Receipts for July,	9,238,974	10,068,394

	1906. Pounds.	1905. Pounds.
Receipts for August,	8,778,101	10,376,813
Receipts for September,	6,688,729	7,743,859
Receipts for October,	6,983,522	6,549,119
Receipts for November,	3,990,993	3,135,224
Receipts for December,	2,838,032	3,688,555
Total supply,	75,341,898	72,337,436
Exports for twelve months, deduct,	5,146,297	2,551,319
Net supply,	70,195,601	69,786,017
Stocks in storage December 29, deduct,	6,851,825	10,189,575
Consumption for twelve months,	63,343,776	59,596,542
Increase in consumption for 1906,	3,747,234	–

MILK.

The price of market milk has been raised in various cities in the Commonwealth during the year 1 cent per quart to the consumer, but it has rarely been the case that there has been a net gain of 1 cent per quart to the producer. The price of milk in Boston was nominally raised 1 cent per quart to the consumer October 1. The price paid the farmer was raised 1½ cents per eight-quart can. As these cans actually hold eight and one-half quarts, the net raise to the farmer per quart was .1764, or between ⅙ and ⅕ of a cent per quart, — nearer ⅙ than ⅕, — hardly enough, it would seem, to meet the additional expense of present cost of and care in producing clean market milk. Allusion has been made elsewhere to the improvement in matters of handling on the part of the milk contractors in recent years. This has not come about all at once, but nevertheless it has reached a point where the cost of running business has very materially increased. Just what this cost is no one knows but themselves. There is no doubt, however, upon one point, and that is, if the milk producers of this Commonwealth are to be put on a safe financial basis, more than 3⅕ cents per quart must be the net price paid to the farmer at his door. The actual necessary cost of producing a quart of milk, even under crude conditions, is not far from 3 cents at the present time.

According to the report of the United States Department of Agriculture last year, after investigating the milk supply of the city of Boston, Mr. Whitaker estimated that from 80 to 85 per cent of the milk consumed in greater Boston is brought in by the railroads. In the twelve months from Dec. 1, 1905, to Dec. 1, 1906, these railroads reported to the Railroad Commissioners 114,233,976 quarts of milk brought into Boston, which is understood to be exclusive of the cream which is shipped in by freight. If we call the milk brought into greater Boston by the railroads four-fifths of that consumed, we have 142,762,470 quarts as the total amount brought in; and a raise of 1 cent per quart, whenever such raise actually takes place, means an increase of $1,427,624.70, which looks like a very large sum.

Professor Alvord found that the average consumption of milk in the country was practically two-thirds of a pint per day per capita. On this basis, a raise of 1 cent per quart would mean not far from $1.20 per person per year, or $6 for an average family of five persons, from which standpoint it does not look large, and can hardly be said to be a burden. The consumer, the contractor and the farmer will have to adjust this matter some day, when the latter may get a fair price for clean, pure milk.

That market milk has improved in the matter of temperature and cleanliness is shown by the last report of the board of health of the city of Boston, from which we learn that the milk samples taken from contractors in 1904 showed 35.6 per cent over 50° F., and in 1905 only 6.33 per cent, — a reduction of nearly 600 per cent. In 1904, 18.87 per cent showed over 500,000 bacteria per cubic centimeter; and in 1905, only 12.25 per cent, — a reduction of practically 33⅓ per cent; and we may reasonably expect the present year will show further improvement.

Appended are the figures concerning carred milk, as reported by the various railroads to the Railroad Commissioners.

Milk brought into Boston by the Different Railroads, December, 1904, to December, 1905, as reported to the Railroad Commissioners.

DATE.	Boston & Albany (Quarts).	Boston & Maine (Quarts).	New York, New Haven & Hartford (Quarts).	Total Quarts.
1904.				
December,	1,042,236	5,766,858	1,680,430	8,489,524
1905.				
January,	1,042,236	5,812,340	1,785,684	8,640,260
February,	982,702	5,367,590	1,658,750	8,009,042
March,	1,225,445	6,248,083	1,859,833	9,333,361
April,	1,539,268	5,897,420	1,891,945	9,328,633
May,	1,693,217	6,740,252	1,942,144	10,375,613
June,	1,689,188	7,030,686	1,832,331	10,552,205
July,	1,618,783	6,810,708	1,795,917	10,225,408
August,	1,483,684	6,370,690	1,780,497	9,634,853
September,	1,426,876	5,838,342	1,680,085	9,945,303
October,	1,457,418	6,296,463	1,849.950	9,603,431
November,	1,239,461	5,662,587	1,727,047	8,629,095
Totals,	16,440,514	73,842,019	21,484,595	111,767,128

Milk brought into Boston by the Different Railroads, December, 1905, to December, 1906, as reported to the Railroad Commissioners.

DATE.	Boston & Albany (Quarts).	Boston & Maine (Quarts).	New York, New Haven & Hartford (Quarts).	Total Quarts.
1905. December, .	1,283,500	6,198,697½	1,779,626	9,261,823½
1906. January, . .	1,332,604	6,147,201½	1,857,863	9,337,668½
February, . .	1,205,300	5,320,639	1,699,607	8,225,546
March, . .	1,536,120	6,134,064	1,837,624	9,507,808
April, . .	1,587,060	6,051,116	1,902,188	9,540,364
May, . .	1,769,768	6,596,392	1,876,023	10,242,183
June, . .	1,759,177	6,964,326	1,913,221	10,636,724
July, . .	1,695,886	6,640,927	1,724,948	10,061,761
August, . .	1,630,869	6,372,150	1,610,180	9,613,199
September, .	1,541,245	6,369,436	1,623,933	9,534,614
October, . .	1,524,968	6,266,043	1,686,887	9,477,898
November, .	1,383,409	5,812,806	1,598,172	8,794,387
Totals, .	18,249,906	74,873,798	21,110,272	114,233,976

The following table shows the wholesale price of milk sent to the Boston market for the last ten years: —

Summer Price.

	Gross Boston Price (Cents).	"Straight Price," Boston (Cents).	Gross to Producer, Fifth Zone (Cents).	Straight Price to Producer, Fifth Zone [1] (Cents).
1897, April to October, .	31	–	22	–
1898, " " .	31	–	22	–
1899, " " .	31	–	22	–
1900, " " .	33	–	24	–
1901, " " .	33	31	24	22
1902, " "	36 in April, July, August, September. 35in May, June.	34 in April, July, August, September. 33 in May, June.	27 26	25 24
1903, " " .	37½	35½	28½	26½
1904, " " .	37½	35½	28½	26½
1905,[2] " " .	37½	35½	28½	26½
1906, " " .	37½	35½	28½	26½

Winter Price.

1897-8, October to April,	33	–	24	–
1898-9, " "	33	–	24	–
1899-0, " "	33	–	24	–
1900-1, " "	37 to January. 35 to April.	–	28 to January. 26 to April.	–
1901-2, " "	36 40in December.	34½ 38½in December.	27 31	25.5 29.5
1902-3, " "	39½	37½	30½	29
1903-4, " "	39½	37½	30½	28½
1904-5, " "	39½	37½	30½	28½
1905-6,[3] " "	39½	37½	30½	28½
1906-7, " "	41	39	32	30

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[1] The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk delivered at the railroad station.

[2] The so-called Knapp tables, allowing a variation of 16⅔ per cent either way from the given basis of uniform production, were made a part of this year's contract. Should the producer exceed this limit, up to a certain point the penalty is that he is obliged to take 1 cent less per can for his entire month's production; if he exceeds that point or second limit, another cent less and so on.

[3] It was agreed that in case the cans were washed and returned clean, ½ cent per can should be deducted.

CREAMERIES AND MILK DEPOTS.

Appended we give a revised list of the principal creameries and milk depots owned and operated by Massachusetts individuals and corporations. There are in this State, in addition to these, a number of distributing plants for creameries owned and operated in other States. For instance, the Maine Creamery Company of Bangor, Me., has offices at 12 Foster Wharf, Boston. The Turner Centre Creamery of Auburn, Me., has distributing houses in Boston, Worcester, Taunton and Lowell, and ships to these points butter, cream, and to one at least skimmed milk.[1] The New England Creamery of Livermore Falls, Me., distributes through a Massachusetts company of the same name in Everett, which also distributes the "Hampden Creamery" goods. The Lyndonville Creamery of Lyndonville, Vt., has a plant at Watertown, from which it distributes milk, cream and butter. J. L. Humphrey, Jr., has four plants, one each in New Bedford, Fall River, Taunton and Brockton, for the distribution of butter and renovated butter (and sometimes cream) from his Iowa creameries. The Armours, Swifts, Hammonds, Morrises and other large packing houses, all representing western-made goods, distribute quantities of butter and renovated butter from their numerous establishments scattered over the State. Some of these also put out oleomargarine. Besides these, there is a considerable number of creamery companies and so-called creameries which buy their stock of producers in this and other States. These in the aggregate do a large business. Other private dairies or creameries also have town offices, restaurants, etc. The above is difficult of strict classification.

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[1] Pasteurized skimmed milk and cream are put together in the proper proportions required for standard milk, in the Boston plant, and the milk thus made is placed upon the market.

Creameries and Milk Depots in Massachusetts.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	Amherst Creamery,	Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	Proprietary,	E. A. King.
Amherst,	Dairy Farming Course, Massachusetts Agricultural College.	Educational,	Prof. W. P. Brooks, director.
Ashfield,	Ashfield Creamery,	Co-operative,	Geo. G. Henry.
Belchertown,	Belchertown Creamery,	Co-operative,	M. G. Ward, president.
Boston, 494 Rutherford Avenue,	H. P. Hood & Sons,[1]	Proprietary,	H. P. Hood & Sons.
Boston, 793 Boylston Street,	Walker-Gordon Laboratory Co.,	Proprietary,	Walker-Gordon Laboratory Co.
Boston, office 1171 Tremont Street,	Alden Bros.,[2]	Proprietary,	Charles L. Alden.
Boston, Wales Place,	Elm Farm Milk Company,	Proprietary,	James H. Knapp, manager.
Boston, 556 Rutherford Avenue,	D. Whiting & Sons,	Proprietary,	D. Whiting & Sons.
Boston, 388 Rutherford Avenue,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.

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[1] H. P. Hood & Sons also have milk depots at Dorchester, Lynn and Salem.

[2] Creamery at 28 Duncan Street.

Creameries and Milk Depots in Massachusetts — Continued.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Boylston,	Adelphia Creamery,	Proprietary,	E. M. Laws.
Bridgewater,	Plymouth County Creamery,[1]	Proprietary,	S. Neilson Houlburg.
Cambridge, 158 Massachusetts Avenue.	C. Brigham Company,	Proprietary,	C. Brigham Company.
Cheshire (P. O., Adams),	Greylock Creamery,	Co-operative,	C. J. Fales, president.
Cheshire,	Highland Creamery,	Proprietary,	Clayton W. Prince.
Cheshire,	West Shore Creamery,	Proprietary,	Seth W. Curtis.
Conway,	Conway Creamery,	Proprietary,	Boston Dairy Company.
Cummington,	Cummington Creamery,	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	Egremont Creamery,	Co-operative,	H. O. Harrington.
Everett,	Hampden Creamery Company,	Proprietary,	Hampden Creamery Company.

Framingham (P. O., South Framingham).	Echo Farm Company,	Proprietary,	W. E. Marchent.
Fitchburg, 26 Cushing Street,	Fitchburg Creamery,	Proprietary,	G. S. Learned.
Gardner,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Groton,	Lawrence Creamery,	Proprietary,	Myron P. Swallow.
Heath,	Cold Spring Creamery,	Proprietary,	I. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery,	Proprietary,	Clark & Soloman.
Lee,	Lenox Creamery,	Co-operative,	P. A. Agnew, manager.
Leominster,	Leominster Creamery,	Proprietary,	C. F. Paige Company.
Marlborough,	Este's Creamery,	Proprietary,	F. F. Este.
Monson,	Monson Creamery,	Proprietary,	W. C. Moulton.
Montague,	Montague Creamery,	–[2]	W. A. Pease, manager.
Monterey,	Berkshire Hill Creamery,	Co-operative,	M. V. Thompson, president.
New Boston,	Berkshire Creamery,	Co-operative,	N. H. Snow, president.

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[1] Cream only.

[2] Leased and operated by Tait Bros., Springfield.

Creameries and Milk Depots in Massachusetts — Concluded.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
New Salem (P. O., Millington), .	New Salem Co-operative Creamery Company.	Co-operative, .	W. A. Moore.
North Brookfield, ...	North Brookfield Creamery, . .	Proprietary, .	H. A. Richardson.
Northfield, ...	Northfield Creamery, . . .	Co-operative, .	L. R. Smith.
Orange (P. O., North Orange), .	North Orange Creamery, . . .	Co-operative, .	C. E. Dunbar.
Shelburne Falls, ...	Totman's Creamery, . . .	Proprietary, .	T. M. Totman.
Southborough, ...	Deerfoot Farm, ...	Proprietary, .	S. H. Howes, manager.
Springfield, ...	Springfield Milk Association, . .	Co-operative, .	F. B. Allen.
Springfield, ...	Tait Bros., ...	Proprietary, .	Tait Bros.
Uxbridge, ...	Farnum Creamery, ...	Proprietary, .	Geo. A. Farnum.
Warren, ...	Worcester County Creamery Association.	Co-operative, .	F. N. Lawrence, treasurer.
Westfield (P. O., Wyben), . .	Wyben Springs Creamery, . .	Co-operative, .	C. H. Wolcott.

West Newbury,	West Newbury Creamery,	Co-operative,	R. S. Brown, treasurer.
West Stockbridge,	Borden Condensed Milk Co.,	Proprietary,	C. E. Hardy, manager.
Williamsburg,	Williamsburg Creamery,	Co-operative,	E. T. Barrus, president.
Worthington (P. O., Ringville),	Worthington Creamery,	Co-operative,	M. R. Bates, superintendent.
Worcester,	Wachusett Creamery,	Proprietary,	E. H. Thayer & Co.

Expenses.

The following is a classified statement of the expenses for the eleven months ending Nov. 30, 1906: —

Bureau: compensation and travelling expenses,	$445 74
Agents: compensation,	1,901 50
Agents: travelling expenses and samples purchased,	2,300 23
General agent: travelling and necessary expenses,	555 04
Chemists: analyses, tests, court attendance,	763 50
Printing and supplies,	200 99
Educational,	249 66
Total,	$6,416 66

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

C. D. RICHARDSON.
JOHN M. DANFORTH.
HENRY E. PAIGE.

THIRD ANNUAL REPORT

OF THE

STATE FORESTER.

REPORT OF THE STATE FORESTER.[1]

To the General Court.

PART I. — COVERING THE TIME BETWEEN JAN. 1 AND SEPT. 15, 1906.

This office has continued its activities, during the time covered by this report, along the lines pursued heretofore. The following pages contain a review of the work done, together with some notes on forest conditions in this Commonwealth and recommendations for their betterment.

Forestry Lectures at the Agricultural College.

Fifty-one students attended the course in forestry at the Agricultural College this year past. The year before there were twenty-nine, making eighty in all who have taken the course. The course deals with the subject in its application to the farm wood lot.

Interest in the study of forestry has been stimulated by the offer of the J. D. W. French prize by the Bay State Agricultural Society, and two prizes for the best essays on the farm wood lot by a friend of the college.

Public Lectures and Addresses.

In addition to the lectures at the Agricultural College, nineteen public lectures on forestry were given during the year, making a total of sixty-two since the office was established. As in the case of wood lot examinations, the applicants for lectures pay the actual travelling and subsistence expenses of the forester.

The Inter-state Conference at Charlotte, N. C.

An inter-state forestry conference was held in Charlotte, N. C., on March 3. The State Forester was invited to attend and deliver an address on the State forestry work in Massachusetts. The invitation was accepted and the address delivered.

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[1] House Document No. 200, 1907.

The White Mountain and Southern Appalachian Reserves.

In April the State Forester was appointed on a committee to urge the passage by Congress of the bill to create the White Mountain and Southern Appalachian Forest Reserves. An account of the proceedings at Washington is contained in the report of the Massachusetts delegation to the Governor, which report is here given: —

His Excellency CURTIS GUILD, Jr., *Governor of Massachusetts.*

SIR: — We have the honor to report that the seven gentlemen commissioned by you to represent the Commonwealth of Massachusetts at the hearing in Washington, April 25, before the committee on agriculture of the House of Representatives, in behalf of the bill for the acquisition of lands suited to national forest reserve purposes in the Appalachian Mountains, within the States of Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Alabama and Tennessee, and the White Mountains, in the State of New Hampshire, were all present at the place and time appointed for the hearing. These representatives were Mr. Theophilus Parsons, Mr. Harvey N. Shepard, Mr. Alfred Akerman, Mr. D. Blakely Hoar, Prof. J. Rayner Edmands, Dr. O. G. Duhamel and Mr. Edwin A. Start. Mr. Shepard was also accredited as the representative of the Appalachian Mountain Club, Mr. Hoar of textile manufactures representing a capital of about one hundred and fifty million dollars, and Mr. Start of the Massachusetts Forestry Association.

The hearing was continued, at the wish of the committee on agriculture, on Thursday, the 26th, when all of the Massachusetts delegation were present except Mr. Parsons and Dr. Duhamel, who were called home by pressing engagements. In addition to the personal presence of the delegation and the petition presented by Mr. Hoar on behalf of numerous manufacturers, letters presenting in the strongest manner the sentiment of the Commonwealth in favor of this measure were filed with the committee on agriculture from yourself, and from Mr. James Richard Carter, Mr. Amory A. Lawrence and Mr. Charles A. Stone, who were unable to accept your request to be present in person as members of the delegation.

Other States officially represented, through commissions appointed by their governors, were Maine, New Hampshire, Rhode

Island and Connecticut; North Carolina, South Carolina, Georgia, Maryland, Virginia, West Virginia, Tennessee and Alabama.

The American Forestry Association was likewise represented by prominent directors from Pennsylvania and the District of Columbia. The Governors of New Hampshire and North Carolina headed the delegation from their States, and Gov. R. B. Glenn of North Carolina acted as chairman of the united delegations, Mr. Start of Massachusetts serving as secretary.

The speakers on behalf of the measure on Wednesday were Gov. John McLane of New Hampshire, Mr. Theophilus Parsons of Massachusetts, Maj. Augustine T. Smythe of South Carolina, Prof. L. C. Glenn of Vanderbilt University, Tennessee, Dr. E. A. Smith, State Geologist of Alabama, and Prof. J. H. Stewart, director of the Agricultural Experiment Station of West Virginia. At the second session on Thursday the speakers were Dr. E. E. Hale, Mr. C. C. Goodrich of Connecticut, Mr. Watson, Commissioner of Agriculture of South Carolina, Mr. Shepard, of Massachusetts, and Governor Glenn of North Carolina, who closed the case for the petitioners both north and south.

The presentation was so arranged as to bring out through experts the varied interests involved: the manufacturers, who are dependent on the water power conserved by the mountains in which the proposed forest reserves lie; the transportation interests on the rivers, which are endangered by silting carried by the wash from denuded areas; the agricultural interests in the measure; its importance for the preservation of the most important health and recreation resorts east of the Mississippi; and the necessity of perpetuating the lumber supply in a region adapted by nature for that and no other production. The argument was wholly from the practical and economic standpoint, except when Mr. Shepard presented, with a clearness and force that brought spontaneous applause, the real significance of the argument for health and for recreation, and the true meaning of the argument for sentiment along these lines. Governor Glenn's closing argument was a powerful summing up along all the lines presented by the preceding speakers.

The delegation was received Wednesday afternoon by President Roosevelt, who pronounced himself heartily in favor of the proposed legislation. After the session on Thursday the delegates were pleasantly received by the Speaker of the House of Representatives.

The general impression among members of Congress and others who are in close touch with the situation in Washington is that an excellent impression was made upon Congress by the delegation, and members of the committee have led us to anticipate a favorable report of the measure at an early day. The bill is already before the Senate, supported by a favorable report from the committee on forest reservations, whose chairman, Senator Brandegee of Connecticut, has it in charge in that body. We are assured that it is likely to pass the Senate without much opposition. A continuance of evidence of the urgent desire for the passage of the measure by the people of the eastern States seems likely to secure its passage.

Respectfully submitted for the Massachusetts delegation,

THEOPHILUS PARSONS, *Chairman.*
EDWIN A. START, *Secretary.*

Publications.

As rapidly as information about the forest problems of the Commonwealth is gotten together, it is published in concise form for the use of woodland owners and such other citizens as may take an interest in forestry.

These publications have not only been in demand in this State, but requests for them have come from other States and foreign countries. The publications to date are as follows: —

"Forestry in Massachusetts,"	Bulletin No. 1
"Forest Thinning,"	Bulletin No. 2
"Report of the Committee of 1905 on the Taxation of Forest Lands,"	Bulletin No. 3
"Practical Suggestions for the Massachusetts Tree Planter,"	Bulletin No. 4
"Forest Fires,"	Bulletin No. 5
"Arbor Day,"	Leaflet No. 1
"Shade Trees,"	Leaflet No. 2
"Forestry and the Schools,"	Leaflet No. 3

The number of copies published amounts to 35,000.

The report on the taxation of forest lands was first printed as House Document No. 134. Requests for copies were so numerous that the supply was soon exhausted. Later it was published as a bulletin of this office.

Correspondence.

Numerous inquiries about forestal matters have been received through the mails. Every effort has been made to answer inquiries in bulletins and leaflets, in order to keep the correspondence from absorbing an undue amount of time. In spite of this, inquiries had to be answered by letter at the rate of 2,500 per annum.

The State Forest Library.

Gifts of books and pamphlets continue to come in. Callers who desire to consult these works are always welcomed and assisted in every way possible.

Practical Assistance to Owners of Woodlands.

Fifty-five applications have been received to date. Forty-seven of these, representing 9,357.53 acres, have been examined, and advice as to treatment and management has been given. This advice is embodied in a written report to the owner. In seven cases a forest map has been constructed to accompany the report.

Wood lot examinations are made at the owners' expense, as provided for in chapter 409 of the Acts of 1904. This line of work is regarded as the most important undertaken, and as much time as can be spared from other duties is devoted to it.

The State Forest Nursery.

The State forest nursery is on the grounds of the Agricultural College, at Amherst. The site has been changed to one more favorably located than the one used last year. Seedlings from the nursery are distributed at cost prices to owners who are operating under a systematic planting plan. The distribution is made in the order of application. This spring past the distribution was at the rate of $3 per thousand seedlings, as follows: —

Fred. A. Smith, Ipswich, 2,450 chestnut,	$7 35
J. M. Tyler, Amherst, 2,000 chestnut,	6 00
George A. York, Marston's Mills, 100 red oak,	30
	$13 65

The stock of seedlings on hand is as follows: —

White ash,	90,000
White pine, 1 year,	45,000
White pine, 2 year,	650
Red spruce,	15,000
Beech,	1,200
Yellow poplar,	130
Oak,	100
Hickory,	70
Total,	152,150

Volume Tables.

The collection of data for the construction of volume tables for white pine was begun in the fall of 1905.

Measurements of more than 1,300 white pine trees were taken, and these have been elaborated, with the assistance of the United States Forest Service. The result is a set of volume tables that are the most complete and accurate that have been prepared in this Commonwealth or in this immediate section.

Mr. Ralph C. Hawley, M.F., assistant in this office, had charge of the execution of this piece of work, and credit for its success is due to him.

The purpose of this work is to devise an easy way to ascertain the quantity of lumber in standing white pine trees. It is easy to measure the amount of lumber in a felled tree, but to estimate standing timber requires more experience than is possessed by the average owner; this is particularly true in the case of the small owner. Volume tables, *i.e.*, tables giving the contents of different-sized trees, afford a means of easily approximating the contents of standing trees and wood lots.

It is believed that such tables, applying directly to the white pine in Massachusetts, will be of great service to wood lot owners; for if the average owner knows the amount of wood in his lot, he will be led to take a greater interest in its care, and when the time for selling the timber arrives, he will be able to secure the real value of his product. At the present time the owners are often at a great disadvantage in arranging a sale, because they do not know the amount of timber standing on their lots.

In preparing the tables which follow, pains were taken to make them as accurate as the nature of the tree growth will permit, and also as general in their application as possible. Where it was practicable to do so, the felled trees, after being measured, were followed through the mill, and the amount of lumber sawed out was ascertained. The data thus obtained furnished a means of reducing the work to a thoroughly practical basis, and of checking any possible errors of calculation.

The tables give the average volume of individual white pine trees of different diameters and heights. As various units prevail in different parts of the Commonwealth for measuring the contents of logs and trees, it has been necessary to make a table for each of the principal units employed.

In Bristol and Plymouth counties, for example, ⅝-inch boards are the standard unit among local lumbermen; and therefore one of the tables gives the volumes of standing trees in ⅝-inch boards. Throughout the northern section of the Commonwealth the contents of the trees and wood lots are usually estimated in cords; and Table II. is based on this unit. The regular board foot, however, is the unit most widely employed, and it was used in constructing Table III. Since the measurements of the same trees were used in preparing the tables, with uniform height of stump and cutting limit in the top, the figures in the different tables can be readily compared and the relations of the different units of measurement established.

Tables IV. and V. are of more scientific than practical value. They give the volumes, in cubic feet, both outside and inside the bark, of the merchantable portion of the trees.

TABLE I. — *Volume Table, in Board Feet, for White Pine in Massachusetts.*

Volume in ⅝-inch boards, surface measure, and when cut into logs 50 inches long. Volume up to 4-inch top. Stumps taken at ½ foot.

DIAMETER, BREAST HIGH (INCHES).	TOTAL HEIGHT (FEET).						
	30	40	50	60	70	80	90
	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.
5, ...	10	–	–	–	–	–	–
6, ...	15	20	30	–	–	–	–
7, ...	30	35	50	65	80	–	–
8, ...	35	50	70	85	110	–	–
9, ...	45	65	90	110	140	155	–
10, ...	–	85	110	140	170	195	–
11, ...	–	105	135	170	205	240	275
12, ...	–	125	165	205	145	290	300
13, ...	–	145	190	240	290	345	390
14, ...	–	–	225	280	340	400	450
15, ...	–	–	260	320	385	460	515
16, ...	–	–	295	360	440	525	590
17, ...	–	–	–	405	490	585	665
18, ...	–	–	–	445	545	655	745
19, ...	–	–	–	485	600	725	815
20, ...	–	–	–	525	650	795	895
21, ...	–	–	–	–	705	865	970
22, ...	–	–	–	–	760	930	1,050
23, ...	–	–	–	–	815	1,000	1,130
24, ...	–	–	–	–	870	1,070	1,205
25, ...	–	–	–	–	925	1,145	1,285

TABLE II. — *Volume Table, in Cords, for White Pine in Massachusetts.*

Volume up to 4-inch top. Stumps taken at ½ foot. Caliper rule.

DIAMETER, BREAST HIGH (INCHES).	TOTAL HEIGHT (FEET).						
	30	**40**	**50**	**60**	**70**	**80**	**90**
	Cords.	Cords.	Cords.	Cords.	Cords.	Cords.	Cords.
5,	.03	–	–	–	–	–	–
6,	.03	.04	.05	–	–	–	–
7,	.04	.05	.07	.09	–	–	–
8,	.05	.07	.09	.11	.13	–	–
9,	.07	.09	.11	.13	.16	–	–
10,	–	.11	.13	.16	.19	.22	–
11,	–	.13	.16	.19	.23	.26	.30
12,	–	.15	.19	.22	.27	.31	.35
13,	–	.17	.22	.26	.31	.36	.40
14,	–	–	.25	.30	.34	.41	.45
15,	–	–	.28	.34	.40	.46	.51
16,	–	–	.32	.38	.44	.52	.58
17,	–	–	–	.42	.49	.58	.64
18,	–	–	–	.47	.55	.64	.71
19,	–	–	–	.51	.60	.70	.79
20,	–	–	–	.55	.66	.77	.87
21,	–	–	–	–	.72	.85	.95
22,	–	–	–	–	.78	.92	1.04
23,	–	–	–	–	.84	1.01	1.13
24,	–	–	–	–	.90	1.08	1.22
25,	–	–	–	–	.97	1.16	1.32
26,	–	–	–	–	–	–	1.42
27,	–	–	–	–	–	–	1.51

TABLE III. — *Volume Table, in Board Feet, for White Pine in Massachusetts.*

Scaled by rule made from mill tallies. Volume up to 4-inch top. Stumps taken at ½ foot.

DIAMETER, BREAST HIGH (INCHES).	TOTAL HEIGHT (FEET).						
	30	**40**	**50**	**60**	**70**	**80**	**90**
	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.	Bd. Ft.
5, ...	10	–	–	–	–	–	–
6, ...	15	20	30	–	–	–	–
7, ...	20	30	40	50	65	–	–
8, ...	25	35	50	65	85	–	–
9, ...	30	45	60	80	105	115	–
10, ...	–	55	75	95	125	145	–
11, ...	–	65	90	115	145	170	200
12, ...	–	75	105	135	165	200	230
13, ...	–	90	120	155	190	235	260
14, ...	–	–	135	175	215	265	300
15, ...	–	–	155	195	245	300	340
16, ...	–	–	175	215	270	335	380
17, ...	–	–	–	240	300	370	420
18, ...	–	–	–	260	325	405	465
19, ...	–	–	–	280	355	445	510
20, ...	–	–	–	305	385	485	555
21, ...	–	–	–	–	420	525	605
22, ...	–	–	–	–	450	570	650
23, ...	–	–	–	–	480	620	700
24, ...	–	–	–	–	515	665	750
25, ...	–	–	–	–	555	715	800
26, ...	–	–	–	–	–	–	855
27, ...	–	–	–	–	–	–	905

TABLE IV. — *Volume Table, in Cubic Feet, for White Pine in Massachusetts.*

Volume outside bark up to 4-inch top. Stumps taken at ½ foot.

DIAMETER, BREAST HIGH (INCHES).	TOTAL HEIGHT (FEET).						
	30	40	50	60	70	80	90
	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.
5, ...	1.8	–	–	–	–	–	–
6, ...	2.6	3.3	4.3	–	–	–	–
7, ...	3.4	4.4	6.1	7.7	–	–	–
8, ...	4.5	6.0	7.8	9.8	12.0	–	–
9, ...	5.9	7.7	10.0	12.0	15.0	–	–
10, ...	–	9.6	12.0	15.0	17.9	20.9	–
11, ...	–	11.6	14.6	17.9	21.4	24.9	28.7
12, ...	–	13.9	17.6	21.1	25.3	29.8	33.7
13, ...	–	16.2	20.4	24.8	29.2	34.7	38.7
14, ...	–	–	23.7	28.7	32.5	39.6	43.6
15, ...	–	–	26.8	32.6	37.9	44.5	49.5
16, ...	–	–	30.5	36.5	42.3	49.8	55.9
17, ...	–	–	–	40.3	47.2	56.7	62.3
18, ...	–	–	–	44.6	52.6	61.5	69.1
19, ...	–	–	–	49.0	57.9	67.8	76.9
20, ...	–	–	–	52.9	63.2	74.7	84.8
21, ...	–	–	–	–	69.1	82.0	92.6
22, ...	–	–	–	–	74.9	89.3	101.4
23, ...	–	–	–	–	81.3	98.1	110.8
24, ...	–	–	–	–	87.1	104.9	119.0
25, ...	–	–	–	–	94.0	112.6	128.8
26, ...	–	–	–	–	–	–	138.6
27, ...	–	–	–	–	–	–	147.3

TABLE V. — *Volume Table, in Cubic Feet, for White Pine in Massachusetts.*

Volume inside bark up to 4-inch top. Stumps taken at ½ foot.

DIAMETER, BREAST HIGH (INCHES).	TOTAL HEIGHT (FEET).						
	30	40	50	60	70	80	90
	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.
5, ...	1.5	–	–	–	–	–	–
6, ...	2.3	3.0	3.7	–	–	–	–
7, ...	3.3	4.1	5.2	6.3	8.0	–	–
8, ...	4.2	5.5	6.8	8.5	10.8	–	–
9, ...	5.1	7.0	8.7	10.7	13.5	15.0	–
10, ...	–	8.7	10.6	13.4	16.3	18.5	–
11, ...	–	10.4	12.9	16.0	19.3	22.5	25.5
12, ...	–	12.3	15.3	19.0	22.7	26.5	30.0
13, ...	–	14.0	18.0	22.0	26.5	31.0	34.5
14, ...	–	–	20.8	25.5	30.0	35.5	39.5
15, ...	–	–	24.0	28.7	34.0	40.5	44.5
16, ...	–	–	27.3	32.3	38.5	45.5	50.5
17, ...	–	–	–	36.0	43.0	51.0	56.5
18, ...	–	–	–	39.5	47.5	56.5	63.0
19, ...	–	–	–	43.2	52.5	62.0	69.5
20, ...	–	–	–	47.0	57.5	68.0	75.5
21, ...	–	–	–	–	62.5	74.5	82.5
22, ...	–	–	–	–	67.5	81.0	90.0
23, ...	–	–	–	–	73.0	88.0	97.0
24, ...	–	–	–	–	78.5	95.0	104.5
25, ...	–	–	–	–	84.0	102.0	112.0

Travel.

In order to keep the office in close touch with the men on duty in the woods or in lecture work, a system of card diaries has been employed. These show that the State Forester and his assistants travelled 10,293 miles on duty during the nine and a half months covered by this report. The record of travel is referred to as an indication of the activity of the service.

A Forest Map.

The collection of data for a forest map of the Commonwealth has been carried on in collaboration with the Bureau of Statistics of Labor. Skeleton maps of sections of the Commonwealth's area were obtained, and the extent of woodlands has been sketched in on these, and at the same time notes have been made as to the age and character of the growth. When this work is completed the sections will be joined, to form a complete forest map of the Commonwealth. The work has not progressed far enough to warrant a definite report as to results. The indications are, however, that the map will furnish more satisfactory information about the extent and value of woodlands than we now possess.

Co-operation with the United States Forest Service.

The plan of co-operation between this office and the United States Forest Service, which was outlined in my first annual report, continued in force until September 10, when my request for a transfer from the detailed list to the furloughed list of the United States Service was granted. The request was made because I was about to leave the service of the Commonwealth (as noted on page 325).

It is important that this office should work in close touch with the United States Forest Service, for a failure to do so might easily lead to a great deal of duplication of work and unnecessary expense. I hope that co-operation may be continued by my successor.

Expenditures and Receipts.

As there was a deficiency last year, due to the failure of the General Court to appropriate the full amount specified in the law creating the office, a statement is given of the expenditures of 1905, as well as of 1906; $4,544.05, including the deficiency, was appropriated for 1905, which amount is accounted for as follows: —

Salaries of assistants,	$2,269 06
Travelling expenses (not included in co-operative funds),	496 23
Instruments,	674 48
Stationery and other office supplies,	707 77
Printing,	209 60
Postage,	129 30
Miscellaneous,	56 14
Balance unexpended,	1 47
	$4,544 05

The appropriation for the eleven months constituting the fiscal year of 1906 was $4,583.33, which is accounted for as follows: —

Salaries of assistants,	$2,035 20
Travelling expenses (not included in co-operative funds),	400 46
Instruments,	81 50
Stationery and supplies,	449 42
Printing,	420 58
Postage,	109 60
Miscellaneous,	84 85
Balance Sept. 15, 1906,	1,001 72
	$4,583 33

Receipts from the United States for services rendered under the co-operative agreement (referred to on page 319) amounted to $208.33. Receipts for two farmers' institute lectures, under the auspices of the State Board of Agriculture, amounted to $20. There was realized $13.65 from sale of seedlings from the nursery (referred to on page 311). This makes a total of $241.98 received during the year, which amount has been turned over to the Treasurer and Receiver-General.

Travelling and subsistence expenses incurred in examining wood lots (page 311) and in delivering lectures (page 307), which were borne by applicants: —

John A. Baldwin, Marion,	$2 60
Franklin B. Dexter, Fairhaven,	5 80
East Medway Grange, Millis,	1 36
Executive department, travelling expenses of delegate to Washington and return,	37 45

Fitchburg Woman's Club, Fitchburg,	$2 53
Francis B. Greene, New Bedford,	1 45
Hampshire County Pomona Grange, Easthampton,	1 17
Dwight B. Heard, Cherry Brook,	9 22
W. R. Hannum, Easthampton,	30
C. D. Hosmer, Orange,	2 06
J. H. Hutchings, Phillipston,	24 21
C. A. Judd, South Hadley,	12
State Board of Agriculture, travelling expenses, lecture at Lancaster,	2 40
Laurence Minot, Wareham,	5 75
George P. Morse, West Wareham,	2 45
New England Box Company, Greenfield,	9 50
Old Colony Pomona Grange, Stoughton,	95
Board of Prison Commissioners, West Rutland,	8 96
F. A. Smith, Ipswich,	1 40
Lewis A. Wright, Gardner,	3 03
On deposit with the State Forester: —	
Dwight B. Heard, Cherry Brook,	15 78
W. O. Whitcomb, Egremont,	50 00

The Taxation of Woodlands.

As stated in last year's report, there is a great deal of dissatisfaction with the present method of assessing taxes on forest lands. This dissatisfaction is shown by the laws that the different States are enacting along these lines. Pennsylvania has a rebate system; if a private owner will fulfill certain conditions, he receives a portion of his taxes back after they have been paid. Connecticut, Massachusetts and other States also have special laws in regard to the taxation of certain classes of woodlands. For the most part these laws are not operative because they were not carefully thought out. They serve to show the feeling of discontent with the present system, but they do not furnish a satisfactory solution of the problem.

The system, now generally in vogue, of assessing forest lands for the purpose of taxation, provides for the taxation not only of the land but of the growing crop as well. A farmer's wheat crop is not taxed while it is growing. An orchard or a vineyard yields returns in a very few years, but the wood lot is oftentimes taxed for years before any returns come in. Suppose, for example, a piece of land is planted to white pine, which is to be cut fifty years from now. As soon as that pine has reached a size at which it adds any value to the land, the property is assessed accordingly until it is cut, when it is again put back to the value of the land without the crop. In other words, the present system provides for the taxation of raw material, not only once, but many times. When this raw material is universally used in our manufactures, such heavy taxation is of doubtful expediency, granting it to be fair, which it is not. It hinders the increase of wealth by taxing it at its source.

So there is dissatisfaction for two reasons: first, the crop as well as the land is taxed, which is not the case with ordinary agricultural crops; and, second, the crop is taxed while it is not bringing in anything, and therefore the owner is not in a condition to pay taxes on it.

The committee appointed in 1905 to investigate the taxation of woodlands reported to the General Court of 1906. The report was printed as House Document, No. 134, which was referred to the General Court of 1907 for action. A further consideration of this report is recommended, as it is the result of the most thorough investigation of this question ever made in America.

The need of reform along this line is emphasized by the fact that most of the woodlands of the Commonwealth are in the hands of private owners, and the private owner's actions are influenced largely by self-interest. Although the State may acquire certain lands for State forests, still, the great body of woodlands will always remain in the hands of individuals. Now, it is to the communities' interest that private holdings should continue to produce, generation after generation, the greatest possible amount of useful material; and the individual owner should be given every reasonable chance to harmonize his interests with those of the community. A reform in our tax laws as applied to woodlands would be a step towards bringing private and public interest together.

State Forests.

The Commonwealth ought to extend its policy of park reservation to include genuine State forests. The reservations that have been made so far are distinctly for park purposes; there are, however, considerable areas in these reservations that could be used for timber growing. Portions of the Middlesex Fells and the Blue Hills reservations might be so utilized without any reduction in their value as parks; on the contrary, their park features would be enhanced. The same might be said of Mount Wachusett, Mount Tom and Greylock reservations, the Province Lands on the Cape, and the land surrounding the Clinton reservoir. The land about this reservoir is already being planted by the Metropolitan Water and Sewerage Board. The forest in the Mount Wachusett reservation is also being improved by the commission which has that reservation in charge. It is to be hoped that all of the boards and commissions having State lands under their charge will follow these good examples, and make the lands that the State owns as productive of forest supplies as is consistent with the purposes for which they were acquired.

But the lands mentioned are small in area, and the State might well follow the precedent established by several other States, and acquire lands for the purpose of growing timber on them. New York has a forest reserve of 1,436,000 acres, and Pennsylvania has acquired 572,000 acres for forest purposes. New Jersey, Connecticut and other States have also adopted reservation policies.

Lands for forest reservations can very often be acquired at a small cost. A few years ago Connecticut bought 900 acres, at an average cost of only $1.64 per acre; in Massachusetts they could be had for $5 and under. There are large areas of overgrown, stony, abandoned pastures, cut-over lands that have been burned repeatedly, scrub oak lands and the like, that are in such conditions that an individual owner cannot afford to improve them. The State can afford to bring these lands into productivity for the common weal. When once well stocked, the sale of mature timber should not only provide for the maintenance of such reservations, but should return a net revenue into the treasury of the State. Some of the European governments obtain as much as $4 net per annum from each acre in the State forest.

In addition to their use for timber production, such reservations furnish recreation grounds for the people. This use for recreative purposes under reasonable restrictions is not inconsistent with the production of timber. The arguments which caused the Commonwealth to appropriate $6,380,000 for the metropolitan parks and considerable sums for the other State park reservations apply in no part to the acquisition of State forests.

The educational effect of well-managed State forests is one of their chief advantages. They should as far as is consistent with their economical management, be widely distributed over the State, in order that they may serve as object lessons in practical forestry.

Forest Fires.

Forest fires continue to be a menace to the woodlands of the Commonwealth. Investigations into the cause, prevalence, extinguishment and prevention of forest fires were begun as soon as this office was established. They were temporarily interrupted by the special investigation of taxation of forest lands, ordered by the General Court of 1905, but they were resumed this year and carried to a conclusion. The results of this investigation are embodied in Bulletin No. 5 of this office.

It is recommended that action be taken to improve the present forest fire service.

Appropriations Insufficient.

In view of the fact that the work has been hampered by the lack of funds to carry it on properly, it is recommended that section 6 of chapter 409 of the Acts of 1904, which is, "A sum not exceeding five thousand dollars may be expended annually by the state forester, with the approval of the governor and council, in carrying out the provisions of this act," be amended to read: "A sum not exceeding six thousand dollars may be expended annually by the state forester, with the approval of the governor and council, in carrying out the provisions of this act."

Summary of Recommendations.

1. That the laws relative to the assessment of woodlands for taxation be amended.
2. That a fund for the purchase and maintenance of State forests be created.
3. That steps be taken to improve the system of protection from forest fires.
4. That appropriations for the State Forester's office be increased from $5,000 to $6,000.

Resignation of the State Forester.

In April I was elected to the chair of Forest Engineering in the University of Georgia, of one branch of which (Franklin College) I am a graduate. My reasons for accepting the professorship were explained in a note to the Governor, as follows: "I do not leave the service of the Commonwealth because of dissatisfaction with my work; on the contrary, I have enjoyed my service here as only one can who loves to fight for a good cause. Nor does the place in Georgia carry a larger salary; but I believe that it offers a better opportunity to forward the cause for which we foresters are working, and I feel it my duty to go."

My resignation was accepted, to take effect on Sept. 15, 1906.

Respectfully submitted,

ALFRED AKERMAN,
State Forester, Aug. 12, 1904, to Sept. 15, 1906.

PART II. — REPORT OF THE STATE FORESTER FROM SEPT. 15, 1906, TO DEC. 31, 1906.

To the General Court.

Having been appointed State Forester, to succeed Mr. Alfred Akerman, I assumed supervision on September 15, and therefore the following report covers the time from that date until the end of the year.

The policy has been to carry forward the work already in hand, and get thoroughly in touch with the purpose of the office.

A letter was addressed and sent out quite generally, in order to acquaint the public with the change of administration. The letter follows: —

To All interested in the Forestry Problems of Massachusetts.

Having been appointed to the position of State Forester, I take this opportunity to say that in assuming my official duties I sincerely wish your hearty co-operation in furthering all true and worthy interests relative to forestry problems within this Commonwealth.

In accepting the position, I do so with the assurance and belief that all organizations and individuals interested in forestry will lend an assisting hand to further promote and develop this great and much-neglected economic industry.

It is believed that the forest service work throughout the State can be made a great blessing, provided people who own lands acquaint themselves with the workings of the offices of the State Forester.

I have been engaged in agricultural economics and education in New England for the past eleven years, and forestry instruction at the New Hampshire College, together with its practical application generally, has received my earnest study and natural interest.

The forest crop needs much skill and science in handling, for best results. There are thousands of acres at present practically idle through mismanagement, that should and eventually must be made a great resource to the Commonwealth. Let us check this unnecessary loss, and foster modern methods in rural affairs. Education and example are our tools to work with.

In behalf of the position which I hold as State Forester, I therefore extend to you a cordial invitation to consult my office at any and all times on forestry matters, and let it be generally known that the office is established by the State to accomplish great good for the whole State in general and each individual in so far as practicable.

(Signed) Yours very sincerely,
F. W. Rane.

Room 7, State House.

Mr. Joseph J. Dearborn, a Harvard forestry student, was appointed assistant on October 1.

In accordance with section 6 of chapter 409 of the Acts of 1904, the expenditures from September 15 to December 1 were as follows: —

Salaries of assistants,	$503 38
Travelling expenses,	161 29
Instruments,	72 20
Stationery (office supplies),	112 45
Printing,	106 00
Postage,	78 60
Miscellaneous,	54 94
	$1,088 86

In accordance with section 5 of the above-named act, the following receipts for travelling and subsistence were received: —

Geo. W. Beals, Norfolk,	$2 79
E. A. Bowen, Lakeville,	2 50
Geo. M. Whipple, Newburyport,	2 02
W. F. Whitney, South Ashburnham,	5 70
Dr. H. W. Nelson, Marshfield Hills,	1 85
Dr. H. W. Nelson, Marshfield Hills,	3 15
L. E. Ware, Norfolk (paid by owner).	
C. S. Davison, South Williamstown,	8 82
J. T. Palfrey, Norfolk,	96
W. G. Nickerson (paid by owner).	
R. B. Corey, Scituate,	1 08
Mrs. E. H. Woods, Acton,	1 00
Oxford Agricultural Society and Grange, Dudley,	4 50
Farmers' and Mechanics' Club, Holden,	3 25
Total,	$37 62

On deposit with the State Forester: —

R. B. Corey, Scituate,	$8 92
Dwight B. Heard,	13 62
Total,	$22 54

Besides the above, the office has been constantly made use of by people on all kinds of forestry problems, and the correspondence has been fairly large and interesting.

It is the purpose of the office to make its usefulness felt in the most effective way. Conferences have been asked for, and in most cases already held, with the leading organizations of the State, through which channels immediate results can be had. Such organizations are represented by the grange, State Board of Agriculture, Massachusetts Agricultural College, other colleges, Board of Education, Federation of Women's Clubs, press, Board of Trade, normal schools, etc. The Massachusetts Forestry Association has co-operated in every way possible.

Since accepting this position the forester has addressed the following organizations: the Society for the Promotion of Agricultural Science, the State Grange, the Boston Market Gardeners' Association, the Massachusetts Forestry Association, and has attended the annual meeting of the Massachusetts State Board of Agriculture and the American Association for the Advancement of Science.

Several trips were made during the fall into various sections of the State, in order to get better acquainted with forestry conditions.

After studying the forestry problems in so far as time would permit since accepting my present position, it would appear evident that there are several problems needing more careful attention, with a view to enacting some practical laws whereby better results can be obtained in systematizing modern forestry in the State. Those I would call attention to particularly are: —

1. Better forest fire protection.
2. Regulation of forest taxation.
3. A State forest reserve policy.
4. A more definite general educational system for enlightening our people and coming generations on the great economic importance of the forest crop.

Respectfully submitted,

F. WM. RANE,
State Forester.

EARLY AGRICULTURAL EDUCATION IN MASSACHUSETTS.

BY

FREDERICK H. FOWLER, B.Sc.

PRINTED UNDER THE DIRECTION OF THE EXECUTIVE COMMITTEE OF THE MASSACHUSETTS STATE BOARD OF AGRICULTURE.

EARLY AGRICULTURAL EDUCATION IN MASSACHUSETTS.

BY F. H. FOWLER, B.SC., FIRST CLERK AND LIBRARIAN, MASSACHUSETTS STATE BOARD OF AGRICULTURE.

The purpose of this paper is to show that the need of education in agriculture was early present in the minds of citizens of Massachusetts, and to trace the expression of this need and the efforts put forth to meet it.

It has not been deemed expedient, however, to carry the subject beyond the year 1863, the year in which the Massachusetts Agricultural College was incorporated and began its work.

Probably the first recorded expression of this need is found in the published proceedings of the Massachusetts Society for Promoting Agriculture, under date of 1796, in which the trustees state: —

> They have thought it would coincide with the design of their Institution, to offer to the Public the original communications, and the extracts from approved authors, which are contained in the following sheets . . . The Trustees of the Society feel themselves responsible not only to their immediate constituents, but to the community at large, for the faithful execution of their trust; but they are to be considered rather as the medium, or organ of communication to the public, of such agricultural knowledge as is scattered throughout the State; . . . They therefore earnestly request all persons to communicate freely the results of their experiments in agricultural matters, to suggest objects for premiums, and any observations they may make respecting any branch of husbandry.[1]

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[1] Rules and Regulations of the Massachusetts Society for Promoting Agriculture, etc., pp. 3, 4. Boston, 1796.

Again we find this society in 1800 framing and publishing a set of inquiries addressed to the farmers and cultivators of the State, requesting information on almost every interesting subject of agriculture. The corresponding secretary of the society, referring to this matter, said: —

> Doubtless the principal object of the gentlemen, who then composed the Board of Agriculture, in sending forth these queries, was to enable them to make a correct analysis of the actual progress and state of agricultural science in Massachusetts; to ascertain its defects as well as its advantages; to compare the processes and crops of one part of the Commonwealth, with those of another; and to contrast the whole with the proceedings and products of other countries.[1]

The following is from an "Historical Address" by Hon. Charles G. Davis, at the Massachusetts Agricultural College, Amherst, June 21, 1887: —

> It was in 1807 that a new era in the progress of agricultural education dawned in New England, which, at first little noticed, was destined to mark an eventful change and to hasten the progress to an agricultural development. Up to this time, so far as can be learned, no agricultural society had thought of a "cattle show" with premiums to be awarded in public, but the societies had confined themselves to printed publications, and to awards for essays and field crops and for the importation of the best sheep. In the autumn of 1807 Mr. Elkanah Watson . . . procured the first pair of merino sheep which had been introduced into Berkshire, and perhaps the whole Commonwealth. . . . Mr. Watson gave notice of an exhibition of his two sheep on the public square in Pittsfield. . . . On the 1st of August, 1810, an appeal drawn by Mr. Watson and signed by twenty-six persons appointed an exhibition of stock on the 1st of October. This effort was successful, and resulted in a charter of the Berkshire Agricultural Society the ensuing winter of 1811.

A marked expression of this need of education in agriculture is found in "An Address to the Essex Agricultural

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[1] The Massachusetts Agricultural Repository and Journal, Vol. IV., 1816, p. 281.

Society at their First Cattle Show, at Topsfield," by Andrew Nichols, Esq., on Oct. 5, 1820. In this address Mr. Nichols said: —

> The present enlightened governor of the state of New-York has hinted, in an address on this subject, the establishment of agricultural schools for the purpose of improving the art of husbandry. And, is it altogether visionary to suppose, that the best interests of this county would be promoted by the establishment of an agricultural academy, where such studies, as are best calculated to make accomplished and scientific farmers might be advantageously pursued, and the students required by turns to labour one or two days or half days every week, with an experienced husbandman and gardener, who should be selected to manage a farm connected with the institution. Such a seminary, well endowed and properly managed, would furnish more useful instructors for town schools in agricultural districts than can now be obtained. It would answer all the purposes of a pattern-farm, rapidly disseminate knowledge of the greatest improvements in the art, and produce the most accomplished farmers and useful citizens.[1]

This expression leads to the consideration of the subject of agricultural instruction in academies.

Agricultural Instruction in Academies.

In the autumn of 1824 Mr. Tyng brought before the trustees of Dummer Academy (Newbury, Essex County) a plan for increasing the usefulness of the school by the creation of an agricultural department. A committee to whom the subject was referred soon after reported that they had conferred with the trustees of the State Agricultural Society, who had expressed their willingness to undertake the establishment of an agricultural institution, on condition of receiving a long lease of the academy lands, to be used as an experimental farm. No change was proposed in the existing school, unless to make it more strictly classical. For a while everything looked favorable, and the trustees went so far as to give their tenant a three-months notice to quit.

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[1] Transactions Essex Agricultural Society, 1820, p. 40. Salem, 1821.

But the officers of the State society, on more mature consideration, declined to co-operate in the measure except as individuals. A petition for aid was then presented to the State Legislature, which proved unsuccessful.[1]

On the occasion of the annual cattle show of the Essex Agricultural Society, held at New Rowley, Sept. 25, 1834, Ebenezer Moseley in his address referred to this attempt, and said: —

> It is not many years, since an application was made to the Legislature of this State, by the Trustees of Dummer Academy, in this county, for aid in founding a professorship of scientific and practical agriculture, as connected with the institution. . . . This institution is exceedingly well adapted for an agricultural school, and with but small aid from the Legislature might be rendered highly useful to the community. Young gentlemen might here come and study agriculture as a science, and be prepared to follow it through life as an honorable profession. This application was deemed of so much importance, that a committee from the Massachusetts Agricultural Society came to the farm, examined it and made a favorable report to the Legislature, recommending that the petition of the trustees should be granted. It is to be regretted that the application did not meet with success. Yet I am not without hope that the Legislature will feel the importance of the subject, and will extend its aid to establish some institution for learning scientific and practical agriculture. Shall schools and colleges be deemed important to diffuse general knowledge, shall military and naval academies have the fostering hand of government to impart knowledge in their departments, shall the sciences and fine arts have teachers for their objects and agriculture alone receive no aid? This art or science which is more important to the prosperity, wealth and happiness of our nation than all others?[2]

Rev. Henry Colman, in his survey of the county of Essex, under the topic "Agricultural Schools," refers to this movement. He says: —

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[1] The First Century of Dummer Academy, by Nehemiah Cleaveland, p. 48. Boston, 1865.

[2] Transactions Essex Agricultural Society, 1834, p. 10. Salem, 1835.

Two literary institutions, one at Beverly, and one at Byfield, are designed in some measure to connect agricultural or mechanical labor with literary education and improvement. They are in this matter as yet in embryo. The latter has ample means in a valuable landed estate contiguous to the school. The former has purchased a valuable estate, and design to apply to the government of the state for aid. Some capital is found necessary in the outset; but I have a strong persuasion, that the introduction of the cultivation of silk in such seminaries where favorably situated, without materially interfering with the literary improvement of the pupils, may do much, under skilful management, towards defraying all the necessary expenses of the establishment. The education which is the fruit of our own honest industry is of vastly more value to the character and self-respect of its favored subject, than that, which is the gift either of public or private charity.[1]

The Essex Agricultural Society was requested in 1840 to advertise a contemplated course of study at the Teachers' Seminary, in Andover, Essex County. This was done under the head of "Agricultural Seminary," as follows: —

We have been requested to present the following notice of a course of study contemplated in the Teachers' Seminary, at the South Parish in Andover. It so fully harmonizes with the views expressed in the foregoing essay (Science of Agriculture, by Dr. A. Nichols), and is so well calculated to meet what we consider the present wants of the community, that we cheerfully recommend the institution to those, who are desirous of educating their sons to be intelligent and independent farmers. At a time when the most distinguished men in our country feel it their highest honor, that they are *farmers;* and, when all the *learned professions*, so called, are *over-stocked*, it becomes us, farmers, to consider what is the best manner of educating our sons.

Arrangements have been made to introduce scientific agriculture as a regular branch of study; one of the teachers has been engaged, during the past winter, in investigating agricultural chemistry, with a view to give instruction on the subject, and to prepare a text book for the use of the students.

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[1] First Report on the Agriculture of Massachusetts, 1837, p. 91. By Rev. Henry Colman. Boston, 1838.

Instruction will be given on the subject the coming term, which commences March 25th, in connection with the lectures and experiments in chemistry. The plan of adding scientific agriculture to the branches already pursued, originated from the belief that scientific agriculture must be made a regular branch of study in our literary institutions before we can make farmers scientific men, and produce a permanent improvement in our system of rural economy. It is our object to afford facilities to our young men for obtaining a thorough English education, especially to obtain a knowledge of the various branches of natural science, that they may be able to understand and apply the great principles of scientific agriculture which lay at the foundation of all successful practice. We propose to teach them botany and physiology, mineralogy, geology, and chemistry with its application to agriculture, and to afford them the opportunity to witness the operations of tillage under the direction of a teacher. No labor will be *required*, but the opportunity will be given for those who feel disposed, and a fair remuneration paid. The instruction in scientific agriculture will be connected with the processes of analyzing soils. Fully believing that this plan will be of the highest practical advantage to the farming community, and the only one which will ultimately elevate the employment, and raise up a generation of scientific farmers, we confidently present it to the community for their co-operation and patronage.[1]

I am indebted to Mr. Jonathan E. Holt, Andover, for the following information: —

The Teachers' Seminary opened in 1830 in a stone building on Andover Hill, fully equipped with chemical laboratory and physical apparatus; also lecture rooms for 200 scholars. Connected with the school was a farm of about 150 acres. The trustees in 1838 voted that instruction in scientific and practical agriculture be added to the duties of the teacher of mathematics. The catalogue of 1841 states: —

Arrangements have been made for teaching Scientific & Practical Agriculture. Instruction is now given by lectures, but a text book is in course of preparation, and when it is completed, Agriculture will be taught as a regular branch of study.

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[1] Transactions of the Essex Agricultural Society, 1840, p. 136. Salem, 1841.

Opportunity will thus be afforded for witnessing the process of analyzing soils and for obtaining a theoretical and practical acquaintance with Agriculture in its various departments. Courses of lectures experimental and theoretical on Chemistry and Chemistry applied to Agriculture and the Arts will be given.

The catalogue of 1842 stated that "A text book has been prepared and Agriculture will hereafter be taught as a regular branch of study." "Gray's Scientific and Practical Agriculture," by Alonzo Gray, M.A., teacher of chemistry and natural history in the seminary, was used. In 1843 the seminary was merged into the "English department" of Phillips Academy, owing to lack of funds, and evidently the agricultural department ceased, as no further records are found. The academy farm was maintained in good shape up to four or five years ago. Most of it is now used for "golf" and hay.

Early in 1856 the selectmen of the town of Westfield, trustees of Westfield Academy, and citizens of the town, petitioned the Legislature as follows: —

That in order to increase its usefulness the Trustees have been desirous of connecting with it an Agricultural Department for better instruction than can now be readily obtained in the art and science of Agriculture which design is generally approved by the inhabitants. That by the Will of Mr. Stephen Harrison lately deceased in this Town the sum of Five Thousand Dollars, is left in the hands of Trustees to be applied to that purpose as soon as a sufficient amount is obtained from other sources to properly establish such a Department, and the said Trustees have determined so to appropriate said bequest as soon as the additional sum of Five Thousand Dollars is so obtained.

Chapter 148 of the Acts of 1856 was entitled "An Act to aid in the Establishment of an Agricultural Department in Westfield Academy." It authorized the inhabitants of the town of Westfield, Hampden County, to vote and appropriate not exceeding $5,000, to be applied by the trustees of Westfield Academy in the establishment of an agricultural department. Admission to this department was to be free to the inhabitants of said town, upon such conditions as might be determined by a board of examiners, to be composed of the school committee of said town and an equal number of the trustees of said academy.

I am indebted to Mr. Ralph H. Cushman of Bernardston for the following facts relative to Powers Institute: —

At a meeting of the trustees held Nov. 15, 1859, it was voted to refer the matter of memorializing the Legislature, for the purpose of obtaining pecuniary aid from the State for an agricultural professorship, to a committee of five, to consider the matter and report at a future meeting of the Board of Trustees. At a meeting held Jan. 7, 1860, it was voted that the memorial to the Legislature be adopted and signed by all the trustees present. A committee of five was appointed to present the memorial to the Legislature.

The petition, dated March 16, 1861, recited the establishment and growth of Powers Institute, and stated: —

> Mr. Ward, the Principal of the Institute, with the sanction of the Board of Trustees, established an Agricultural Department in said school, in which the elementary and practical principles of all the different branches of Agriculture should be taught, the same as Geography, Geometry, Civil Engineering or Botany have heretofore been taught: — that classes have been formed for the Study of Agriculture, having regular recitations at stated periods — and that considerable progress has, in that way, been made in what your memorialists believe to be, a somewhat new method of studying. Two obstacles have impeded the progress which we believe, would, otherwise, have been made, — viz. 1st the want of a proper Text Book for the Scholars; — and 2nd the want of a proper person properly qualified by study, observation and experience to teach and lecture in that particular branch. The first of those difficulties, your memorialists are glad to learn, will soon be remedied by the publication of a "Manual of Agriculture for Schools," by the Board of Agriculture of this Commonwealth. But the second obstacle cannot be adequately removed without further pecuniary means.

Mr. Cushman further states that the records show that "in the spring term of 1859 a class was formed numbering nearly 80. Lectures were delivered before the class by Hon. Simon Brown, Concord, Hon. Chas. L. Flint and others."

Farm School, Thompson's Island, Boston.

I am indebted to Superintendent Charles H. Bradley for the following information concerning Thompson's Island Farm School: —

> As regards agriculture, I quote from a report on the Farm School prepared by Hon. Charles H. Jackson, chairman, dated Jan. 27, 1832: "It is proposed to remove these boys from the city . . . and to place them on a farm where some of the more common mechanic trades may be practiced; so that labors in which they will be daily instructed and engaged, either in gardening, agriculture or the useful arts will contribute to their health and support and tend at the same time, to form in them habits of industry and order, and prepare them to earn their livelihood." As a result of this report, the "Proprietors of the Farm School" purchased Thompson's Island and at once began operations here. "On Easter Monday, April 8, 1833, desirous of commencing operations for the future Farm School on so appropriate a day, Mr. E. M. P. Wells with Mr. Cook and three boys made a visit to the Island, had prayers in the farm house and planted a mulberry tree and some potatoes." In the next report I read: "A school is kept both morning and evening for about six hours daily in which are taught the elements of useful knowledge, reading, writing, arithmetic, geography and grammar. During the evening, especially in the winter months, instruction is also given in the first principles of agriculture, horticulture, and botany: the different kinds of soils, the most important processes of cultivation and the names, uses and distinctive qualities of seeds, plants and trees are explained and illustrated. . . . And they are required to perform as much of the manual labor done on the farm as their various ages and capacities will permit."
>
> It is apparent that the "Proprietors of the Farm School" had especially in mind the instruction of the boys in agriculture and farming operations. As the science has developed, the School has endeavored to keep pace with the times.

In the last report of the Board of Managers, Boston, 1907, it is stated: —

The Farm School is nearing a century of its existence, and in its ninety-third year is doing the work the founders intended. . . . We were the first by seventy years to make agriculture the basis of elementary education. We were the first by several years to formulate and to put in practice a thorough course in agriculture for elementary grades, and to correlate the other subjects of the curriculum with it, as far as practicable. . . .

This report further states that the Farm School is a private charity, dependent for its maintenance upon legacies, donations and annual subscriptions. Also, that it has been the pioneer in several important educational movements.

BUSSEY INSTITUTION.

The Bussey Institution is a school of agriculture and horticulture, established as a department of Harvard University under the trusts created by the will of Benjamin Bussey of Roxbury, Mass., bearing date July 30, 1835.[1]

Mr. Bussey's will was proved and allowed in March, 1842. It conveyed his estate, real and personal, to seven trustees, who, after all the legacies and annuities had been paid or secured and certain life estates had expired, were to convey all the testator's property to the President and Fellows of Harvard College, upon the conditions and for the purposes set forth in the will. Among these conditions and purposes we find the following: —

> that they will retain the estate on which I now live in said Roxbury, called "Woodland Hill;" consisting of over two hundred acres of land, as a place in my judgment well adapted, from the great variety and excellence of its soil, its hills, valleys, and water, its great diversity of surface and exposure, and lastly, its high state of cultivation and improvement, for all the objects contemplated. That they will establish there a course of instruction in practical agriculture, in useful and ornamental gardening, in botany, and in such other branches of natural science as may tend to promote a knowledge of practical agriculture and the various arts subservient thereto and connected therewith, and cause such courses of lectures to be delivered there at such seasons of the year and under such regulations as they may think best adapted to promote

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[1] Bulletin of the Bussey Institution, Vol. I., 1874-1876.

the ends designed; and also to furnish gratuitous aid, if they shall think it expedient, to such meritorious persons as may resort there for instruction: the institution so established shall be called the "Bussey Institution." . . .

Under a provision of the will, in May, 1861, the trustees transferred the property in their possession to the President and Fellows of Harvard College, who set aside a portion as a fund, which they proposed to use for building purposes whenever it should become their duty to organize and equip the "Bussey Institution." They did not begin the organization of the school of agriculture and horticulture, however, until the spring of 1870.

Governor Andrew referred to this matter in his inaugural of 1863.

Smith's Agricultural School.

Oliver Smith died in Hatfield, Hampshire County, Dec. 20, 1845. In his will he provided for a fund for the establishment and maintenance of an agricultural school, in the following manner: —

I direct the said trustees, and it is hereby made their duty, to manage and improve the said fund of thirty thousand dollars as an accumulating fund by annually adding the interest growing out of the same to the principal, until the expiration of the full term of Sixty Years from my decease. And at the expiration of the said term I direct the said trustees to pay over to the town of Northampton, in said county of Hampshire, out of the principal of said fund such amount thereof as may be thought necessary and proper by said town, or its duly appointed agents, for the purpose in the first place of purchasing a Farm, or a tract of land for a Farm, within the limits of the said town, for a pattern farm, to be so improved in practical details as to become a model, as far as can be effected by time and experience, to farmers generally. And in the second place, for the purpose of purchasing another farm, or tract of land for a farm, as near to said Pattern Farm as may be within said town, to be designated for an Experimental Farm, to aid and assist the labors and improvements of the Pattern Farm in the art and science of Husbandry and Agriculture. . . . Secondly, There shall also be established on the premises a School of Industry for the benefit of the poor. The boys to be selected as beneficiaries and pupils shall be of fair character, and shall be taken from the most indigent classes of the community, and shall receive a good common school education, and be instructed in the art and science of agriculture, or in some mechanic art in the shops attached to the premises. . . . Fourthly, the establishment shall be designated and called Smith's Agricultural School.[1]

Provision was also made for the care and management of the matter by the choosing annually by ballot in legal town meeting of three inhabitants of said Northampton, one of whom at least should be a practical husbandman, and one a mechanic, who were to report in writing annually to said town.

STATE REFORM SCHOOL.

This school is located at Westborough, Worcester County, and was established by Acts of 1847, chapter 165. It was opened for the admission of members Nov. 1, 1848. The object of the school is declared to be "for the instruction, employment and reformation of juvenile offenders." The boys are also to be instructed in some regular course of labor, either mechanical, manufacturing, agricultural or horticultural, or a combination of them, as shall be best suited to their age and strength, disposition and capacity.[2]

At a meeting of the State Board of Agriculture, held May 12, 1853, Simon Brown, Harvey Dodge, B. V. French, Edward Hitchcock, J. R. Lawton, J. H. W. Page, John W. Proctor, Joseph Smith, Seth Sprague and Marshall P. Wilder were constituted a committee to confer with the Governor, and consider and report whether any, and if so what, aid might conveniently be afforded by the State to the Board of Agriculture to facilitate experiments in scientific cultivation of the soil by the use of the lands connected with the State Reform School at Westborough.

This committee made a favorable report to the Board on November 16 following, which report was accepted, and a committee was chosen to confer with a committee of the trustees of the said school and to aid them with regard to the preliminary arrangements and the details of the act which it might be desirable for them to recommend. These joint committees petitioned the Legislature of 1854, and chapter 45 resulted.[1]

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[1] From Hampshire Gazette, Nov. 17, 1891.

[2] The Massachusetts System of Common Schools. Tenth Annual Report of the Secretary of the Massachusetts Board of Education, 1849, pp. 143, 145.

The committee of the Legislature to whom the petition was referred made a report, in which the following occurs: —

> The object of the State Reform School was the reformation of juvenile offenders. For the double purpose of supplying milk, vegetables, and other needful agricultural products, and also affording useful and healthful employment to the inmates, a farm was connected with the school; with some recent purchases, it now contains about 285 acres.

The necessary act having been passed, the Board of Agriculture met on April 11, accepted the act, and voted to approve the agreement made by the committees of the trustees and of the Board, dated March 24, 1854. In this agreement we find the following:[2] —

> The purpose of this arrangement is to relieve the Trustees of the State Reform School of the care and management of the agricultural portion of the establishment at Westborough, to provide an experimental farm for the Board of Agriculture, and to furnish greater facilities for the employment and instruction of the inmates of the Reform School in agriculture and horticulture, in accordance with what are believed to have been the views and wishes of General Theodore Lyman, the founder of the institution, while the products of the farm shall continue to be applied for the use of the school substantially as they were while the farm was under the immediate control of said Board of Trustees.

This agreement or contract was made for the term of five years. On April 4, 1855, the joint committees entered into an agreement "that 150 boys shall be employed upon the farm each work day during the present season and so long as the ground shall remain open for farm work, stormy days excepted." During 1857 employment was furnished for about 200 boys a day, and they were instructed, so far as practicable, in the details of practical farming.

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[1] Senate, No. 5, 1854. Agriculture of Massachusetts, 1854 (Part I.), p. 2.

[2] Agriculture of Massachusetts, 1854 (Part I.), pp. 6, 168.

At a meeting of the Board, held Oct. 19, 1858, it was —

> *Resolved*, That it is inexpedient for the Board of Agriculture to take any steps to renew the contract for the further possession and management of the State Farm at Westborough.

At the annual meeting of the Board, held Jan. 18, 1859, a committee was appointed to transfer the State Farm to the trustees of the State Reform School.

AMHERST COLLEGE.

In the Amherst College catalogue of 1843–44 we find Prof. Charles U. Shepard, A.M., listed among the faculty as "Lecturer on Agricultural Chemistry and Mineralogy;" also, that those subjects were made eighth in the list of "Lectures."

At a meeting of the trustees of Amherst College, Oct. 11, 1852, a "Preamble and Plan for a Scientific Department" was adopted.[1] Statement was made that this department was to be entirely independent of the regular college course; also, that "another gentleman in town will take charge of any who may wish to study the elements of agriculture, theoretically and practically." In the plan, under heading "IV. Agriculture," it was stated that "The elements of agriculture will be taught theoretically and practically by the Rev. J. A. Nash. Books: Nash's Elements of Agriculture, Practical and Theoretical. Norton's Elements of Scientific Agriculture. Girardin and DuBreuil's Cours Elementaire D'Agriculture. Johnston's Lectures on Practical Agriculture. Allen's Domestic Animals." Under "III. Chemistry," it was stated that "Instruction in experimental chemistry will be given by Professor Clark. The course will include practical instruction in Analytical and Applied Chemistry, with special reference to Agriculture, Pharmacy and Metallurgy." This "Scientific Department" appears to have been discontinued after the academical year 1856–57.

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[1] Catalogue of the Officers and Students of Amherst College for the Academical Year 1852–53, pp. 24–28.

In 1852–53, William S. Clark, Ph.D., became "Professor of Analytical and Applied Chemistry, and Instructor in German." Rev. John A. Nash, A.M., became "Instructor in Agriculture." In 1853–54, Professor Clark's subjects were changed by substituting zoölogy for German. In 1854–55 his subjects were "Chemistry, Botany and Zoölogy." That year Professor Shepard became "Massachusetts Professor of Natural History."

Massachusetts Academy of Agriculture.

Acts of 1845, chapter 150, being "An Act to incorporate the Massachusetts Academy of Agriculture," established the said corporation in the town of Westborough, Worcester County, and authorized it to hold $75,000 of estate, to be devoted to the purposes of education. The incorporators were Joseph Breck, George Denny, Marshall P. Wilder *et al.*

The petition for this legislation was signed by Joseph Breck and nine others, and they asked for incorporation for the purpose of establishing and conducting an institute for practical instruction in the science of agriculture and horticulture. The committee on agriculture, to whom the petition was referred, by Morrill Allen, reported favorably, and in their report they said: —

> Institutions of this character have been demanded by the almost universal voice of enlightened farmers for a number of passed years. . . . We are not informed of more than one professor of agriculture in all the colleges of New England. It may be difficult, if it be practicable, to establish such professorships in many of our colleges, therefore, we must look chiefly to subordinate institutions for the desired relief. Something has already been effected in several schools which have been formed for the purposes of initiating lads into both the science and practice of agriculture. . . .

Massachusetts Agricultural Institute.

Chapter 242 of the Acts of 1848 made Edward Hitchcock, William B. Calhoun, Samuel L. Hinckley, their associates and successors, a corporation, by name of the Massachusetts

Agricultural Institute, which was authorized to hold $50,000 of real and personal estate "for the purpose of establishing, in some one of the towns lying on the banks of the Connecticut River, or in a town immediately adjoining such towns, an agricultural school and experimental farm, the object of whom shall be instruction in agricultural science, and improvements in all the arts connected with the practice of farming." The management of the affairs of the corporation was to be entrusted to a board of seven trustees, five of whom were to be elected by the corporation, and the other two to be appointed by the Governor and Council. The corporation was to make an annual report to the Legislature, in January, of its progress and the number of its pupils, the condition of its finances, the general course of instruction adopted and pursued, and the results of its agricultural experiments.

This legislation appears to have been the outcome of an order presented to the House of Representatives by Mr. Hubbard of Sunderland, on Jan. 29, 1848, which provided that the committee on Agriculture be instructed to inquire into the expediency of making provision for the establishment of a State agricultural school, or of providing for the maintenance of an agricultural department in connection with one or more of the existing colleges of the Commonwealth.

On Feb. 5, 1848, a petition was presented to the Legislature, in which it was stated that at the annual meeting of the Hampshire, Franklin and Hampden Agricultural Society (Northampton), in the month of October, 1847, it was —

> *Voted*, That this society make application to the next Legislature for the endowment of an Institution in the Connecticut Valley, for instruction in the various departments of agricultural science.

At a meeting of the Hampden Agricultural Society, at Springfield, Feb. 24, 1848, it was —

> *Voted*, That this society approve of the institution of an Agricultural School, to be established in the interior of the

Commonwealth for the promotion of agriculture, and that the officers and members of the society will unite in a petition to the Legislature to locate such an institution.

Such a petition, signed by Aaron Ashley and seventeen others, was presented to the Legislature of 1848.

COMMISSIONERS CONCERNING AN AGRICULTURAL SCHOOL.

Gov. Geo. N. Briggs, in his inaugural address on Jan. 8, 1850, expressed his sympathy with agriculturists in the following words: —

> The application of science to agriculture is attracting the attention of the public, and exciting the interest of those who are engaged in the cultivation of the earth. A better knowledge of the qualities of the soil, and of the nature and properties of the substances necessary to enrich it, than has heretofore been generally possessed, would greatly increase its productions. This knowledge may be derived from science. Chemistry holds this treasure in its hands. Schools and lectures, publications and practical experiments, are the instruments through which it is to be attained. Whatever can be done to promote this desirable object, by legislative aid, is due to this most ancient and useful of all human pursuits, and that large and respectable portion of the community who are engaged in it. Content with the bounties received from the earth, this class of our fellow-citizens have hitherto received but inconsiderable contributions from the government. I cheerfully commend the subject to your favorable consideration and action.[1]

In the Senate, on Jan. 11, 1850, it was ordered that so much of the Governor's address as related to agriculture be referred to the committee on agriculture. The following memorials and petitions in behalf of agricultural education were presented to the Legislature and referred to the same committee: petition of the Trustees of the Massachusetts Society for Promoting Agriculture, by John C. Gray, president; memorial of the Norfolk County Agricultural Society, by C. Francis Adams, Marshall P. Wilder, B. F. Copeland,

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[1] Acts and Resolves of 1850, p. 533.

B. V. French, Edgar K. Whitaker, Edw. L. Keyes, a committee on behalf of the society; petition of the Hampden Agricultural Society, by Josiah Hooker and ninety-five others; petition of the Middlesex Society of Husbandmen and Manufacturers, by Jos. T. Buckingham, president, E. Rockwood Hoar, vice-president, and twenty others; petition of the Worcester County Agricultural Society, by Levi Lincoln, president; and memorial of the trustees of the Essex Agricultural Society, by John W. Proctor, Allen W. Dodge and sixteen others.

On January 31 the joint standing committee on agriculture presented a full report signed by Jos. T. Buckingham, chairman, closing with these words: —

> But concurring in the views so clearly expressed in the several documents referred to their consideration, and adopting, as their own, the arguments therein presented, and by gentlemen of intelligence and patriotism, with whom they have consulted, the committee recommend the adoption of the accompanying resolves.[1]

Then follow five "Resolves concerning the Establishment of an Agricultural School." These resolves passed their several stages, and were approved by Governor Briggs on May 3, 1850. They mark an epoch in the history of agricultural education in Massachusetts, and are so important that they are quoted in full:[2] —

> *Resolved*, That his excellency the governor, with the advice of the council, be requested and empowered to appoint a board of five commissioners, who shall consider the expediency of establishing agricultural schools or colleges, and also of furnishing aid to any existing academy or college, for the instruction of such pupils as may wish to attend such an institution, in all those branches of agricultural knowledge necessary for the advancement of the interests of agriculture in this State.
>
> *Resolved*, That the said commissioners, if, in their opinion it is expedient to establish such agricultural school or college, shall be directed to procure plans and estimates for the buildings necessary for such an institution, and to propose and

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[1] Senate, No. 20, January, 1850. Also, see Senate, No. 25, and House, No. 88, 1850.

[2] Resolves of 1850, chapter 103.

mature a system for the government thereof, with the requisite studies to be pursued at the same, and to ascertain what laws and regulations would be necessary and proper to put the same into successful operation.

Resolved, That the said commissioners be directed to consider the expediency of establishing an agricultural and statistical department, in our state government, that shall maintain a similar relation to the interests of agriculture, and other industrial pursuits, that the board of education does to our system of common school instruction; what appropriations, if any, may be necessary, on the part of the Commonwealth, to secure instruction in this science, in our medical and other colleges, and normal schools; whether any further aid should be granted to local agricultural and horticultural societies; whether instruction in agriculture can properly be introduced into the common schools; and by what other and proper means this branch of industry, so important to the Commonwealth, and so intimately connected with the welfare of the people, may best be promoted.

Resolved, That the said commissioners report the result of their deliberations to his excellency the governor, in season to be communicated to the Legislature at the commencement of their next session. And the said commissioners shall present all their accounts to the governor and council, to be by them audited and allowed, as they may deem just.

Resolved, That the said commissioners consider the expediency of appropriating the property of the Commonwealth in lands, in the state of Maine, or any other available resources, to the general purposes of education, including instruction in agriculture, and to the support of charitable institutions.

The report of the commissioners, making 105 printed pages, was transmitted to the Legislature in January, 1851. It was signed by Commissioners Marshall P. Wilder, Edward Hitchcock, Samuel A. Eliot, Thomas E. Payson and Eli Warren.[1]

This report contained about 60 printed pages concerning the agricultural institutions in Europe, with about 20 pages of "remarks upon the facts," by Commissioner Hitchcock. Some of the more pertinent of these "remarks" are briefly noted:[2] —

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[1] House, No. 13, January, 1851.

[2] *Ibid.*, pp. 68–88.

I. They show us an extraordinary increase of interest in Europe, on the subject of Agricultural Schools, within a few years past. . . .

VI. European Agricultural Schools have taught us some important lessons. . . .

VII. The lowest class of schools in Europe, the Inferior, are not needed in Massachusetts. . . .

VIII. We learn that those agricultural institutions succeed best which are started and sustained by the mutual efforts and contributions of individuals, or societies, and of the government. . . .

IX. We learn, from European experience, that independent agricultural institutions are essential to accomplish the object which is aimed at. . . .

X. Essentially the same reasons, and of greater force, exist for the establishment of Agricultural Schools in this country, as in Europe. . . .

XI. We have, in this country, several advantages over Europeans, for establishing Agricultural Schools. . . .

XII. The conclusion to which my own mind has been brought, by these investigations, is, that Massachusetts should lose no time in taking hold of the business of agricultural education, efficiently and liberally.

I can hardly doubt, from all that I have seen and heard for the last ten years, that there is a strong desire and expectation that the Legislature should move in this matter without delay. I have heard it talked about almost everywhere; it has formed the burthen of a large part of the addresses delivered at the annual agricultural fairs; and at least two gentlemen, at their decease, have left splendid legacies for founding such schools, — one at Roxbury, and the other at Northampton. I refer to Hon. Benjamin Bussey, and Oliver Smith, Esq., of Hatfield. How soon the legacy of the former can be brought into use, for a school at Roxbury, I know not; but that of Mr. Smith will not be available for more than half a century. Yet let no one fear that we shall have too many schools of this description. . . .

The first question that arises, is, What are the objects we may hope to attain by founding agricultural schools in the State?

I reply, and here I must be pardoned for a repetition of some sentiments, —

1. First, such schools would furnish to all classes of the community, an opportunity to acquire a definite knowledge of all the known principles by which agricultural pursuits should be conducted. These principles are the joint results of all the experience men have ever had in husbandry, and of all the deductions they have made from the sciences on this subject. . . .

2. In such schools our youth would find an excellent opportunity of learning the best method of conducting the practical operations of the farm; in other words, of seeing theory reduced to practice. . . .

3. These schools would form centres of information on the subject of agriculture, and from them our farmers could derive important aid. . . .

4. These schools would be the best places for testing the value of supposed improvements in agriculture. . . .

5. They ought to be places for making improvements in agriculture. . . .

6. Finally, to sum up the whole in one word, the grand object of these schools is to improve the husbandry of Massachusetts. . . .

But what shall be the character of the Agricultural Schools, should any be established in Massachusetts?

This difficult inquiry I would meet by a few suggestions. . . . Twenty, or even ten years ago, it might have answered to propose the introduction of agriculture into our primary schools, or as a department in our academies, or a professorship in our colleges. All this it may be well enough to do now, but something more must be done. So Europeans judge, and accordingly, as we have seen, they have started institutions with as ample a foundation, and as numerous a body of instructors, as we find in most of our American colleges. Nothing short of this, as it seems to me, will be sufficient for our country; nay, I fancy that at least one such superior institution is needed in each of our states. The work to be done is too great, the number of teachers is too many, and the amount of various collections too large, to attempt to attach an agricultural school to some other institution, and that too as only a subordinate branch. . . .

OUTLINES OF A PLAN FOR AGRICULTURAL EDUCATION IN MASSACHUSETTS.[1]

I. Let an Agricultural School or College of the superior class be established somewhere in the State, possessed of all the means (teachers, books, apparatus, specimens, farms, &c.) necessary to give a finished education in the principles and practice of agriculture. Such a school, it seems to me, should embrace the following particulars, at least: —

1. A school of instruction, by lectures and recitations, in the following branches . . . : —

2. Collections of the following description . . . : —

3. A model and experimental farm of moderate size, and instruction in practical farming. . . .

4. Provision for Instruction in Ancient and Modern languages. . . .

5. Provision on the farm for the board of those students who are willing to devote their time to labor daily beyond what is required of all. . . .

6. Number of Instructors Necessary. . . .

7. The course of study should embrace two years. . . .

8. For admission, an examination should be required, in English grammar, geography, arithmetic, and Euclid's Elements of Geometry, at least the first five books. . . .

9. The tuition should be as low as possible, certainly not higher than at the existing colleges of the State, and that is about $40. As soon as possible the instruction should be gratuitous.

10. Several scholarships, say as many as ten to begin with, equal at least to the tuition, should be founded by the State. . . .

11. Provided individuals shall offer ten acres of good land, to be improved as a model farm, by some academy, let the State give to that academy (not more than to one in each county,) at least $200 for instruction, and $50 for a library; provided said academy shall agree to cultivate the land, and provide for a department of agriculture: the aid from the State to be withdrawn, however, when the number of students in agriculture shall be less than ten.

12. Let a manual of agriculture be prepared by some competent person, or some existing manual be adopted, and intro-

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[1] House, No. 13, January, 1851, p. 78.

duced into the primary schools, if any children wish to study it. It might be well for the State to furnish the books gratis.

13. One object of these schools of a lower grade should be to prepare pupils to enter the central institution, in advanced standing, if fitted for it.

15. Let the State appoint a Board and Secretary of Agriculture, who shall sustain the same relations to that interest and the schools connected with it, as the Board and Secretary of Education do to primary schools.

Methods by which the State can put the preceding Plan into Operation.

1. The first method would be for the State to assume at once the whole expense and responsibility of the entire system. For the first year the expenses would be nearly as follows: (Total, $70,000.) . . .

2. Let the agricultural institute be located so near some existing literary institution, that the pupils could attend its scientific lectures and study its collections in natural history. . . .

Third Plan for an Agricultural Institution.

I. Let a Board of Agriculture, as in the first plan, be appointed by the Legislature, with the following, among other powers: —

1. To appoint a secretary, one of whose duties for the present should be, to aid in the establishment of agricultural schools, and he should also be expected to give a course of lectures in the central school, should such a one be established and his services required.

2. To appoint a president of such central school or college, with a salary of $1,200, who should be also a professor of some department in the same; also, to appoint a professor of agriculture in the same, with a salary of $1,000. Also, a superintendent of the farm, with a salary from $800 to $1,000.

3. These four officers, the president, secretary, professor of agriculture, and superintendent, should have power, with the board, to select a site for such college, and purchase a farm, containing from 100 to 200 acres, . . .

4. The Board should have power to procure for the school, annual courses of lectures, upon subjects not provided for by the instruction of the president, secretary, professor of agri-

culture, and superintendent, nor by the lectures in the adjacent literary institution; . . .

5. Power to appoint one tutor for every thirty-five scholars in the school, with a salary of $500, . . .

6. Power to make an offer to the public, in behalf of the State, of the prospective endowment of a professorship of elementary and agricultural chemistry; of natural history and geology; of anatomy, physiology, and veterinary medicine and surgery, . . .

7. Power to expend $3,000, the first year, in establishing agricultural departments in as many of the existing academies of the State as shall be judged expedient; . . .

8. Power to make such other arrangements for the management of the new school, as they may judge necessary; . . .

9. Power to invite donations from the citizens of the State, of models and drawings of agricultural instruments, and drawings of animals useful in agriculture; models of varieties of fruit; specimens of insects injurious to vegetation; of the skeletons of animals; of dried seeds, grasses, and grains; of rocks, minerals, and soils; of agricultural and scientific books, and whatever substances, organic or inorganic, may be useful in such a school.

10. Power to invite the friends of agriculture to establish scholarships and prizes in the central school and in the county schools.

11. Power to secure the preparation and introduction into the primary schools of a proper manual of agriculture, to be taught there to those children whose parents wish them to attend to that subject.

12. Were such an arrangement to go into operation, in which the government defrayed half the expense, and individuals the other half, then should the central and the county schools be under the control of trustees, one half of whom should consist of the board of agriculture, and the other half of gentlemen chosen by the donors to the several institutions; . . .

In conclusion, I would only say, that my conviction is, that if Massachusetts desire it, she might, on some such plan as has been suggested, within a very few months, put into operation a system of Agricultural Schools that would ultimately attain a very high character. . . .

All of which is respectfully submitted,

EDWARD HITCHCOCK.

AMHERST, Dec. 16th, 1850.

The commissioners close their report by offering their recommendations on the following conditions: —

1. To carry out the foregoing views, the commissioners recommend the appropriation by the Legislature of twenty thousand dollars, for the purpose of establishing a Central Agricultural College, with a Model and Experimental Farm; said institution to be open to all classes of the Commonwealth, and in the government of which the State shall be interested so far as may be deemed expedient; provided, however, that this sum shall not be drawn for until an equal amount shall have been raised by private donation or legacy, and deposited in the treasury of the Commonwealth, to constitute a common fund for this object.

2. Whenever any incorporated Academy, not exceeding one such institution in each county, shall raise a fund of two thousand dollars or more, towards establishing and supporting a department of agricultural instruction, with lands suitable for experiments, it shall be entitled to draw from the treasury of the Commonwealth, the sum of two hundred dollars annually; provided, however, that whenever the number of scholars receiving instruction in agriculture shall be less than ten, the aid of the State shall be withheld.[1]

The third recommendation provided for the establishment of a State Department of Agriculture, to consist of a board of commissioners and a secretary. This board was to have power to organize and put in operation the college contemplated by the foregoing recommendations.

The fourth recommendation provided for increase of State aid to agricultural societies.

5. That a premium, of such amount as the Legislature may deem judicious, be offered for the best Elementary Treatise on Agriculture, suitable for common schools; said premium to be awarded by the Board of Agriculture, if such be created, or, if not, by a committee to be appointed by the Governor and council.

The sixth recommendation provided for forming a fund, the income of which was to be used, at the discretion of the

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[1] House, No. 13, January, 1851, p. 103.

Legislature, for the encouragement or support of institutions for instruction in agriculture, for charitable purposes, and for education.

The report was referred to the committee on agriculture on March 12, which committee on April 4 reported a bill to establish a State Board of Agriculture.[1] One of the provisions in this bill was, that the proposed board of agriculture might "receive, hold in trust, and exercise control over any donations or bequests from private sources, made to advance agricultural education." This bill, however, was refused a third reading on May 12.

By chapter 112 of the Acts of 1851, however, the Massachusetts school fund was allowed to increase from $1,000,000 to $1,500,000.

Associated Agricultural Convention.

At a meeting of the trustees of the Norfolk Agricultural Society, Jan. 28, 1851, Pres. Marshall P. Wilder made certain suggestions; and, acting on those suggestions, the trustees —

> *Voted*, That the president and secretaries be a committee to mature and adopt a plan for a convention of delegates from the various agricultural societies of the Commonwealth, to be holden at some convenient time and place, the object of which shall be to concert measures for their mutual advantage, and for the promotion of the cause of agricultural education.[2]

At the morning session of that convention, held in the Green Room at the State House, March 20, 1851, President Wilder, announcing the subjects for discussion, said: "It is also to be hoped that the cause of agricultural education, now about to receive the consideration of the Legislature, will not be overlooked in the deliberations of this body."

At the afternoon session, in Representatives' Hall, many of the leading agriculturists of the Commonwealth being present, Mr. Charles C. Sewall of Medfield, from the business committee, reported for the deliberation of the convention certain preambles and resolutions, the fourth, fifth and eighth of which bear directly upon the subject under consideration.

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[1] House, No. 126, 1851.

[2] Agriculture of Massachusetts, 1851, p. 398.

Resolved, 4. That agricultural schools having been found, by the experience of other nations, efficient means in promoting the cause of agricultural education, which is so essential to the prosperity of farmers and to the welfare of communities, it becomes at once the duty and policy of the Commonwealth to establish and maintain such institutions for the benefit of all its inhabitants.

Resolved, 5. That the several plans for an agricultural school, recently reported by the board of commissioners appointed for that purpose, are worthy the profound consideration of the people of Massachusetts, and their representatives in the General Court, as indicating the feasibility and practicability of an establishment worthy that exalted character which the State has secured by the endowment of kindred institutions, designed, like these, for the diffusion of useful knowledge among the people.

Resolved, 8. That the convention respectfully suggests to the Legislature the propriety and expediency of reserving the entire proceeds of the sales of the public lands of the Commonwealth, — from and after the period when the Common School Fund shall have reached the maximum fixed by the Act of 1834, — for the purposes of education and charity, with a view to extending that aid and encouragement to a system of agricultural education, which the importance of the subject so imperiously demands.[1]

The discussion on the different resolutions was continued into the evening session, and among those taking part were Marshall P. Wilder, Gov. George S. Boutwell, President Hitchcock and Professor Fowler of Amherst College, Judge Mack of Salem, John Brooks of Princeton, and William Buckminster, editor of the "Massachusetts Ploughman."[2] The fourth and fifth resolutions were adopted, but the eighth was presumably discarded, though no action to that effect is found. Section 4 of the bill to establish a State Board of Agriculture, rejected by the Legislature of 1851, contained, however, the idea expressed in the eighth resolution.

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[1] Agriculture of Massachusetts, 1851, p. 405.

[2] *Ibid.*, pp. 406–434.

MASSACHUSETTS BOARD OF AGRICULTURE.

This association, composed of three delegates from each of the incorporated agricultural societies in the Commonwealth, was convened Sept. 3, 1851, at the State House in Boston.[1]

On motion of Mr. B. V. French, a committee of five were chosen to report on the subject of agricultural education, and the best measures to be adopted for the encouragement of such education.

Upon this motion, a very able debate followed. The speakers did not differ as to the necessity and propriety of legislative action, but several of them advocated the action of public-spirited individuals jointly with the Legislature, as in the foundation of the State normal schools and the reform school at Westborough. The discussion occupied most of the forenoon session.

The following gentlemen were then chosen this committee, viz.: Pres. Marshall P. Wilder, John W. Proctor, William C. Fowler, J. H. W. Page and Samuel Reed.

The Board met according to adjournment, at the State House, Boston, Jan. 14, 1852.

At this meeting a constitution and by-laws was adopted, the first article of which was as follows: —

> 1. The objects of this association are the encouragement of agricultural education, and the improvement of agriculture in all its departments in this Commonwealth.

President Wilder, in behalf of the committee on agricultural education, submitted a preamble and resolves, as expressing the views of said committee. One of these resolves, at least, is worthy of being quoted in this connection, namely: —

> *Resolved*, That Massachusetts, by an enlightened policy and wise legislation, has rendered her system of education worthy of her exalted reputation, and that this board most earnestly desire her to complete that system, by providing kindred in-

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[1] Agriculture of Massachusetts, 1851, p. 435.

stitutions for the scientific education of the farmer, upon whom is levied so large a share of the taxes for the support of governmental and philanthropic objects.[1]

An animated and interesting discussion took place upon these resolves, and their consideration was continued to an adjourned meeting held at the State House, February 3.[2] At the afternoon and evening sessions the resolutions were further discussed, when Lieutenant-Governor Cushman offered the following resolution, which, after some discussion, was followed by the adoption of the resolutions: —

> *Resolved*, That the resolutions now under consideration be adopted, and that the executive committee be directed to present the same to the Legislature, and to urge such action by that body as may be thought most expedient to carry into practice the *principles* contained in said resolutions.

In pursuance of the resolution adopted by the Board, a memorial, with the resolves on agricultural education, was presented to the Legislature. This memorial closes with the following: —

> Your memorialists do not feel it necessary, on this occasion, to dwell at length on the details of such an institution for agricultural education as it may be proper to establish. These details may be properly left to the wisdom and discretion of those who may compose the board of agriculture, should the Legislature think it expedient to establish such a board. The most important point is to lay the foundation, and to leave the development to time and experience. It may only be observed that provision for instruction by lectures, and the use of the best text books on the one hand, and for practice in an experimental farm on the other, seem to be the two great features of an institution for agricultural education.[3]

This memorial was signed by Marshall P. Wilder, president; Henry W. Cushman and John W. Lincoln, vice-presidents; Edward Everett, John W. Proctor, J. H. W. Page, Wm. C. Fowler, Benj. V. French, executive committee; Allen W. Dodge, corresponding secretary; and Ed. K. Whitaker, recording secretary; and was dated Feb. 4, 1852.

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[1] Agriculture of Massachusetts, 1851, pp. 439–441.

[2] *Ibid.*, p. 477.

[3] *Ibid.*, pp. 489–492.

MASSACHUSETTS SCHOOL OF AGRICULTURE.

At a meeting of the State Board of Agriculture, held Jan. 16, 1856, a committee previously appointed to consider and report to the Board what further measures, if any, were needed to subserve the cause of agriculture in the Commonwealth, made the following report, which was accepted: —

Having given the subject their careful consideration, the committee are of the opinion that nothing would be better calculated to advance the cause of agriculture and foster and direct the growing interest therein throughout the community at large, than the immediate establishment of an experimental farm, and as soon as the funds shall permit, of an agricultural school in connection therewith, where both the science and the practice of farming may be taught in all their departments.

Your committee do not propose to set forth in detail the many reasons which have led them to this conclusion, but they will be pardoned in suggesting one or two of the most important.

First. There is not at the present time, to the knowledge of your committee, any society, or board existing in the Commonwealth authorized by act of the Legislature to hold funds to be applied exclusively to the advancement of scientific and practical agriculture, or the diffusion of knowledge connected with rural economy.

Secondly. In the opinion of your committee, the time has arrived when the wants of the community demand something of this kind; a time when the learned professions seem more than full; when the attention of our citizens, and in particular of our young men, is being more than ever directed to the cultivation of the soil, and when many both wealthy and liberal men in the Commonwealth are holding out the inducement of an ample supply of funds in furtherance of such an undertaking.

Influenced by these considerations among many others, your committee respectfully recommend that a committee be chosen by this Board to apply to the present Legislature for an act authorizing the formation of a board of trustees, capable of holding funds to be applied in establishing an experimental farm and agricultural school connected with it, designed to furnish instruction in every branch of rural economy, theoretical and practical.

B. V. FRENCH.
SETH SPRAGUE.
JOHN BROOKS.

Acting on the recommendation in the above report, the Board appointed Messrs. French, Newell, Sprague, Wilder and Secretary Flint a committee. As a result of this action the Legislature incorporated the Massachusetts School of Agriculture (Acts of 1856, chapter 236).

By this act, Marshall P. Wilder of Dorchester, Benjamin V. French of Braintree, George W. Lyman of Waltham, Seth Sprague of Duxbury, Moses Newell of Newbury, Richard S. Fay of Lynn and Samuel Hooper of Boston (Messrs. Wilder, Newell, French and Sprague were members of the State Board of Agriculture), and their associates and successors, were made a corporation, by the name of the "Trustees of the Massachusetts School of Agriculture," for the purpose of "holding, maintaining and conducting an experimental farm and school thereupon, with all needful buildings, library, apparatus and appurtenances, for the promotion of agricultural and horticultural art within this Commonwealth."

Concerning this movement President Wilder said: —

> This plan seemed to accord better with the phase of public sentiment, and efforts were in progress for the establishment of such a school, which promised to be successful. A liberal proposal had been received from the heirs of William H. Cary, at Lexington, for the establishment of it in that town, another from the city of Springfield, where nearly forty thousand dollars had been subscribed, and an offer of the town farm and buildings had been made by the city on condition of locating the school there. . . . In their report of April, 1861, the Trustees state that they have been induced to locate the School in Springfield, and expressed the hope that they might, at no distant day, lay the foundation of the Massachusetts School of Agriculture, as one of the permanent institutions of the State.[1]

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[1] From "Historical Address" delivered at the Massachusetts Agricultural College, on the occasion of graduating its first class, July 19, 1871.

In 1860 its charter was transferred to several enterprising citizens of Springfield, who determined to raise by subscription $75,000 for the opening of the school in that city, relying upon the Legislature for a further endowment. This project would probably have succeeded, had not the call to arms absorbed public attention.[1]

Plan for an Agricultural School.

On Jan. 30, 1861, Mr. Calhoun of Springfield was instrumental in getting the House of Representatives to adopt the following order: —

Ordered, That the Committee on Education consider and report on the expediency of granting the aid of the Commonwealth to any effort made or making, by an organized association or corporation within this Commonwealth, for the establishment of an Agricultural School — such effort having the concurrence of the Board of Agriculture; and the system of study and practice, to be pursued, being such as shall have the approval of that Board.

It appears that a printed petition was prepared and circulated for signatures, the wording of the petition being as follows: —

Your petitioners, citizens of Massachusetts, respectfully represent that a College, for the purpose of more full and perfect instruction in the science and practice of agriculture and kindred branches, is much needed in this Commonwealth.

That the establishment and endowment of such an institution has been repeatedly recommended by the State Board of Agriculture, and by all classes of persons, in many different ways.

That an effort is now making in Springfield and vicinity, with very flattering success, to raise at least $50,000, for the purpose of laying the foundation of such an institution.

That a location in that city or vicinity is peculiarly favorable for such an institution, being central, easily accessible and affording land of the best quality and greatest variety, at a moderate price.

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[1] History of Higher Education in Massachusetts, by George Gary Bush. United States Bureau of Education, Washington, 1891, p. 364.

> We, therefore, respectfully petition your Honorable Body to encourage the enterprise, by donating from the funds of the Commonwealth, a sum equal in amount to that named above, on such terms and conditions as may seem to your Honorable Body to be proper.

Petitions were presented signed by twenty-eight citizens of Russell, sixty-two of Holyoke, twenty of Westfield, forty of Enfield, fifty-three of Brimfield, twenty of Huntington, twenty-four of West Tisbury, thirty-five of Becket, one hundred and forty-five of Amherst, fifty-one of Princeton, twenty-eight of West Springfield, seventeen of Palmer, twelve of Templeton, ninety-two of Pittsfield, twenty-two of South Deerfield, thirty-two of Greenfield, twenty-nine of Hinsdale, twenty of Chester, eleven of Brookfield, Ralph Clark and forty others, Chas. R. Tracy and forty-two others, Nathan M. Chaffee and thirty-four others, by Pres. George Marston on behalf of the Barnstable County Agricultural Society, and by eleven members of the Franklin Harvest Club.

There was presented, also, a petition signed by eighty-six citizens of Northampton, in which reference was made to the will of Oliver Smith, and closing with the following words : —

> We therefore petition your Honorable bodies to consider the provisions whereby the said sum is to be made available for such a purpose, and if it is deemed that the interests of the Commonwealth require the incorporation of an Agricultural School or College, to consider, if the best interests of the State will not be promoted, by its location in this town, where it may ultimately have the full benefit of this rapidly accumulating fund.

A petition was also presented, signed by Henry W. Cushman and twelve others, calling attention to the establishment of Powers Institute in Bernardston, Franklin County, in 1857, and stating that Mr. L. F. Ward, who became principal in the spring of 1858, had, " with the sanction of the Board of Trustees, established an Agricultural Department in said school." After referring to the work of the new department somewhat in detail, and the obstacles encountered, to the importance of making agriculture a study in our higher seminaries of learning and to the proposed school at Springfield, the petition concludes: —

> Under such circumstances, the Board of Trustees of this Institution, believing that they have commenced a system of instruction in Agriculture, that, if generally adopted, would prove of immense advantage to the people of this Commonwealth; — and feeling that with enhanced means they could accomplish a large amount of good for a class of persons who have heretofore received but little assistance, for educational purposes from the State, — and respectfully pray your honorable body to set aside and appropriate from the sales of the Back Bay Lands, the sum of Ten Thousand Dollars the income from which shall forever be used to support a Professor of Agriculture at Powers Institute in Bernardston.

These several petitions were referred to the committee on education, which committee reported a resolve (Senate, No. 165) in favor of the establishment of an agricultural school or college, accompanied by a report. This report closes as follows: —

> Several educational plans were proposed to your Committee, each having merits and worthy of consideration. We however arrived at the conclusion, that these projects are not sufficiently matured for legislative action, and that the whole subject should be referred to some competent body of men to examine fully and report thereon.
>
> For the Committee,
>
> R. T. Davis, *Chairman.*

The result of all this action was the enactment of chapter 98 of the Resolves of 1861, being a "Resolve in favor of the establishment of an agricultural school or college," and reading as follows: —

> *Resolved*, That the governor, by and with the advice and consent of the council, be and he is hereby authorized to appoint three commissioners, whose duty it shall be to prepare a plan for the establishment of an agricultural school or college, and report the same to the next legislature. Said

commissioners shall receive no pay for their services, but their expenses, including the cost of the required plan, not to exceed two hundred dollars, shall be paid from the treasury of the Commonwealth.

This commission was constituted June 12, 1861, by the appointment of Rejoice Newton of Worcester, Thomas F. Plunkett of Pittsfield and Charles G. Davis of Plymouth.

An order for considering the abolishing of this commission was introduced in the Legislature of 1862, and referred to the committee on agriculture. On April 19 this committee reported a resolve for continuing the commission, accompanied by a report, in which it said: —

> They have communicated with the commissioners and are informed that they have entered upon investigations and inquiries appertaining to their duties, which the Committee believe may result in benefit to the Commonwealth. The present condition of the country and of the finances of the Commonwealth render it inexpedient to make any appropriation from the treasury for an agricultural school at the present time, but the friends of agriculture are making efforts to raise funds for such a school, which they hope may eventually receive the assistance and encouragement of the State, and look forward to the report of the commissioners for valuable suggestions and information. . . . as the commissioners are entitled to no compensation for their services, the Committee are of opinion that the Commission should be continued, and accordingly report the accompanying resolve.
>
> For the Committee,
>
> ORLO BURT.

By chapter 71 of the Resolves of 1862 it was provided that the provisions of the resolves of the preceding year should be "extended one year."

Judge Davis says, of the doings of this commission: —

> The minds of neither of my seniors had ever been directed to the subject, and they met with a feeling that the action of the Legislature was a feint, and that nothing was expected of them. We were advised not to report at once. Mr. Morrill's bill would be again offered under Mr. Lincoln, and if it passed,

the mind of the Legislature would be forced to entertain the subject, and make full inquiry. . . . We met a second time, when I reported concerning Harvard College, and upon some questions as to the Smith fund at Northampton. I have never again had the pleasure of seeing either of these gentlemen before their death.[1]

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Mr. Bush is authority for the following statement: —

> On Feb. 18, 1859, a meeting of about forty "individuals representing associations of agriculture, horticulture, art, science, and various industrial, educational, and moral interests of the State," was held in the library of the Boston Society of Natural History, Mason Street, Boston. This appears to have been the first step in organization of an effort for the promotion of some form of popular and more extended scientific education. . . . At this first meeting Mr. Marshall P. Wilder presided. Professor Louis Agassiz, Hon. A. H. Rice, Mr. John D. Philbrick and others spoke. A committee was appointed to memorialize the Legislature, and did so in March, 1859.[2]

The result of this movement was Acts of 1861, chapter 183, being "An Act to incorporate the Massachusetts Institute of Technology, and to grant Aid to said Institute and to the Boston Society of Natural History." By section 1 certain persons were made a "body corporate by the name of the Massachusetts Institute of Technology, for the purpose of instituting and maintaining a society of arts, a museum of arts, and a school of industrial science, and aiding generally, by suitable means, the advancement, development and practical application of science in connection with arts, agriculture, manufactures and commerce."

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[1] From "Historical Address" delivered at the Massachusetts Agricultural College, Amherst, June 21, 1887.

[2] History of Higher Education in Massachusetts, by George Gary Bush, United States Bureau of Education, Washington, 1891, p. 281. See also House, No. 260, 1859, and House, No. 13, 1860.

Massachusetts Agricultural College.

The Massachusetts State Board of Agriculture was not slow to place itself on record when the movement began in Congress to plan for the establishment of colleges for the benefit of agriculture and the mechanic arts, for we find that on April 7, 1858, the Board —

Resolved, That this Board do most heartily approve of the objects of a bill presented in the House of Representatives, in Congress, Dec. 14, 1857, by Hon. Justin S. Morrill of Vermont, requesting Congress to donate public lands to each State and Territory which may provide colleges for the benefit of Agriculture and the Mechanic Arts, and that our Senators and Representatives in Congress be requested to render their best aid in securing the passage of said bill into a law; and that our secretary be requested to serve each of our Senators and Representatives with a copy of the above.

At a meeting of the Board, on Jan. 8, 1861, Mr. Levi Stockbridge of Hadley offered the following resolution: —

Resolved, That in the opinion of this Board, the time has arrived for the inauguration of measures tending to the establishment of an agricultural school of high grade under the patronage of the Commonwealth.

At a meeting on the 25th of the same month, on motion of Mr. James S. Grinnell of Greenfield, it was —

Resolved, That this Board, believing that the establishment of an agricultural school would advance the interests of agriculture in this Commonwealth, is disposed to give its influence to any well directed plan for such a school.

Following the adoption of this resolution, Messrs. Marshall P. Wilder, Freeman Walker, William S. Clark, Levi Stockbridge and Charles C. Sewall were chosen a committee "to co-operate at their discretion with any men or body of men who may have any plan for an agricultural school, and to present and report their proceedings at the next meeting of the Board."

At a meeting of the Board, on Feb. 27, 1863, Colonel Wilder made a statement of the doings of the above committee. After some discussion, Dr. George B. Loring presented the following resolutions, which were unanimously adopted: —

Resolved, That in the opinion of the State Board of Agriculture, the grant of land made by Congress to the several States, for the establishment of colleges for instruction in agriculture and the mechanic arts, is designed expressly for the general diffusion of useful knowledge in these two branches among the people.

Resolved, That the Legislature is hereby respectfully requested to make such disposition of the grant, as will enable the Board of Agriculture, as immediately representing the farming interests of the Commonwealth, to enlarge its sphere of usefulness by exercising a supervision over the employment of the funds arising from the grant, for the purpose of securing the confidence of the agricultural community, and of conducting such a scheme as will operate for the benefit of those engaged in this business.

Resolved, That in the opinion of this Board, the interests of the State and intentions of Congress require that the grant should be principally devoted to the establishment of an educational institution for the practical and scientific study of agriculture, and for the instruction of youths who intend to follow industrial pursuits, and that the institution should not be immediately connected with any institution established for other purposes.

Resolved, That a committee of five be appointed to present these resolutions to the committee of the Legislature having the subject under consideration, and to express the views of this Board upon the proper disposition of the Congressional grant.

The committee provided for in the last resolve was constituted by the appointment of Messrs. Marshall P. Wilder, Paoli Lathrop, George B. Loring, S. B. Phinney, John Brooks, Henry Colt and Charles G. Davis.

The congressional grant referred to was provided for by "An Act donating Public Lands to the Several States and Territories, which may provide Colleges for the Benefit of

Agriculture and the Mechanic Arts," which was approved by President Lincoln July 2, 1862. Section 4 of this act provided for the investment of certain funds, —

> the interest of which shall be inviolably appropriated, by each State which may take and claim the benefit to this act, to the endowment, support and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectfully prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.[1]

Gov. John A. Andrew, in his inaugural address, on Jan. 9, 1863, referred to this act of Congress, and recommended that the Legislature take measures to secure to the Commonwealth the benefits of the grant.

This portion of his address was referred to a joint special committee, which committee, by Resolves of 1863, chapter 7, was allowed $300 for travelling and other needful expenses.

A 48-page report was made in the Senate, March 26, 1863.[2] The majority report consisted of 30 printed pages. It quoted the act of Congress, referred to "The Fund to be expected from the act," "The Object of the Donation," "How to accomplish the Design," "Object of a Professional College," asked the question, "Shall there be one College or more?" referred to "Connection with other Colleges," and quoted resolutions of the Boston Board of Trade and of the State Board of Agriculture. The report closed with the following "Recapitulation:" —

> 1. Your committee are united in the opinion of the actual demand for the establishment of an Agricultural College on a practical basis, similar to the one in Pennsylvania, in Massachusetts.
>
> 2. That such a college should be wholly disconnected with all existing institutions, and separate from all large cities and towns.

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[1] United States Statutes, Vol. 12, chap. 130, p. 503.

[2] Senate, No. 108, 1863.

3. That it should recognize the principle of daily manual labor by its students as essential to success.

4. That the necessary funds for the founding of the institution should be contributed equally by the State and individuals. . . .

In view of the above facts, we recommend substantially the following: —

1. The grant of Congress to the State of Massachusetts should be received, and the conditions be faithfully complied with.

2. One-tenth of the whole amount should be set apart for the purchase of lands to be used in connection with the agricultural college proper; and of the remaining nine-tenths one-third should be devoted to the use of the Institute of Technology, under the direction of the trustees thereof; and the remaining two-thirds should be devoted to the use of an agricultural college under the control of a board of trustees; and therefore the Committee report the accompanying Bill.

Per order,

E. O. HAVEN, *Chairman.*

Mr. William D. Swan presented a minority report under date of March 30, 1863, with accompanying resolves. He did not appear to be in favor of an independent institution. He favored the appointment of a commission by the Governor "To purchase the life estate which now encumbers the Bussey Institution," and "To enter into consultation with the college and societies which might aid in the establishment and maintenance of an agricultural and mechanical college, and to report to the next Legislature."

The results, however, were the enactment (chapter 166) of "An Act to provide for the Reception of a Grant of Congress, and to create a Fund for the Promotion of Education in Agriculture and the Mechanic Arts," and (chapter 220) "An Act to incorporate the Trustees of the Massachusetts Agricultural College."

By section 4 of the first act it was provided: —

All moneys received by virtue of this act, for the sale of the land scrip, shall be immediately deposited with the treasurer of the Commonwealth, who shall invest and hold the same in accordance with the fourth section of the aforementioned act of congress. The moneys so invested shall constitute a perpetual fund, to be entitled the Fund for the Promotion of Education in Agriculture and the Mechanic Arts, which shall be appropriated and used in such manner as the legislature shall prescribe, and in accordance with the said act of congress.

The act of incorporation was an act of nine sections, the corporators being Marshall P. Wilder of Dorchester, Charles G. Davis of Plymouth, Nathan Durfee of Fall River, John Brooks of Princeton, Henry Colt of Pittsfield, William S. Southworth of Lowell, Charles C. Sewall of Medfield, Paoli Lathrop of South Hadley, Phinehas Stedman of Chicopee, Allen W. Dodge of Hamilton, George Marston of Barnstable, William B. Washburn of Greenfield, Henry L. Whiting of Tisbury and John B. King of Nantucket. (Messrs. Brooks, Colt, Davis, Lathrop, Sewall, Stedman and Wilder were members of the State Board of Agriculture in 1863.) The Governor of the Commonwealth, the secretary of the Board of Education, the secretary of the Board of Agriculture and the president of the faculty were constituted *ex officio* members.

It was left to the trustees to determine the location of the college in some suitable place within the Commonwealth, and they were to secure, by purchase or otherwise, in connection therewith, a tract of land containing at least one hundred acres, to be used as an experimental farm or otherwise, so as best to promote the objects of the institution; and in establishing the by-laws and regulations of said college they were to make such provision for the manual labor of the students on said farm as they might deem just and reasonable. The location, plan of organization, government and course of study prescribed for the college were to be subject to the approval of the Legislature.

When the said college should have been duly organized, located and established, it was to receive two-thirds of the annual income received from the fund created under the act of Congress heretofore referred to; the remaining one-third was to go to the Massachusetts Institute of Technology for instruction in the mechanic arts.

The first meeting of the trustees was held at the office of the State Board of Agriculture, in Boston, on Nov. 18, 1863. The corporation organized by the election of His Excellency John A. Andrew, president; Charles L. Flint, secretary; Allen W. Dodge, vice-president. A set of by-laws was presented and adopted. A committee of five, consisting of Messrs. Wilder, Whiting, Stedman, Durfee and Colt, was chosen, "who shall have in charge the raising of subscriptions to the funds required by law to put the Agricultural College in operation, and also to consider the subject of a location for the college and to receive proposals concerning the same." Adjournment was taken to Jan. 5, 1864.

The Botanic Garden.

By resolves of March, 1805, chapter CVII., on petition of Martin Brimmer and others, a committee of the Massachusetts Society for Promoting Agriculture, praying for aid from government to enable them to establish a botanic garden, certain aid was given for that purpose and a professorship of botany was established.

The botanic garden, founded in 1805, is situated on the northwest corner of Garden and Linnean streets (Cambridge). . . . The choice of a site was made in October, 1807, and to this Andrew Craigie of Cambridge added the valuable donation of four acres of adjoining land. The funds for its formation and support were raised partly by subscription and partly by a grant from the State of some wild lands in the District of Maine. . . . As one enters from Garden Street, to the right is the garden proper, and to the left a chain of buildings in the following order: the professor's house, built in 1810; the herbarium, with a valuable library, laboratory and lecture room attached, and the conservatory. The herbarium is the finest in this country. . . . The ruling spirit here for over thirty years was Prof. Asa Gray.[1]

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[1] History of Higher Education in Massachusetts, by George Gary Bush. United States Bureau of Education, Washington, 1891, p. 122.

The idea in establishing this garden, as outlined in the act above referred to, was the "promoting the arts and agriculture of this State, by collecting, cultivating and ascertaining the uses of all the various kinds of grasses, of the various plants which are provided for medicinal uses, of the plants destined to support the life of man, and of the plants that conduce to promote the arts necessary for his comfort and convenience, and by investigating the history of those insects which are destructive to plants, and the means of preventing their ravages."

Agriculture in the Public Schools.

For some years the opinion had prevailed that the time had come, or was soon to come, when instruction in agriculture should become a part of the work of the public schools of the Commonwealth. In line with this opinion, at the annual meeting of the State Board of Agriculture, Jan. 5, 1860, Mr. Richard S. Fay offered the following resolution, which was adopted: —

> *Resolved*, As the opinion of this Board, that a system of agricultural education should be adopted and form a part of the educational system of the State.

Following the adoption of this resolution, the Board chose by ballot Messrs. Richard S. Fay, Simon Brown and Marshall P. Wilder a committee to prepare a plan for carrying it into effect, and to report to the Board for further action. The committee reported on February 1 following, and their report was accepted.[1]

This report was quite lengthy, and it is thought not best to quote it in full. The committee proposed two things, however, which should be noted: —

> 1st. The ingrafting upon our common school education the study of the elementary principles of geology, of agricultural chemistry, of physiology, and of botany.
>
> 2nd. An agricultural school, with a farm attached to it, in each county, to be devoted exclusively to agricultural instruction, uniting science with correct practice.

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[1] Agriculture of Massachusetts, 1859 (Part I.), pp. 130–138.

The committee recommended the formation of farmers' clubs, the delivery of public lectures, and the circulation of tracts broadcast over the State as a mode of agricultural education. The committee closed their report with the following: —

> In conclusion, the committee would most earnestly urge upon the Board and the friends of agricultural education generally, not to suffer the present session of the Legislature to pass away without attempting, through a legislative enactment, should any be found necessary, to ingraft the first measure in the plan submitted upon our present school system. It appeals so strongly to the good sense and to the sound patriotism of every citizen, whatever his profession may be, it is impossible to believe that the measure, if recommended by the Board, can fail of being adopted.

In the House of Representatives, on Jan. 16, 1862, Mr. Sewall of Medfield offered an order that the joint standing committee on education consider the expediency of including the "elements of agriculture" among the branches to be taught in all the public schools, in which the school committee deem it expedient. This order was considered, and a bill was reported, which, after amendment, was enacted as chapter 7 of the Acts of 1862, being "An Act concerning the Public Schools." This act simply provided that "Agriculture shall be taught by lectures or otherwise, in all the public schools in which the school committee deem it expedient."

FARMERS' INSTITUTES.

At the third meeting of the State Board of Agriculture, Sept. 7, 1852, a committee on the best means of promoting the interests of agriculture in the State by public lectures was appointed. At a subsequent meeting on December 1 this committee submitted a report favoring the calling of the attention of the people to the importance of having lectures on agriculture form a part of the course of all lyceums and similar associations in the rural districts of the Commonwealth. This report was accepted and referred to a committee, who subsequently issued, through the agricultural papers, a notice calling the attention of the friends of agriculture to the subject.

At the next meeting of the Board, Jan. 12, 1853, Dr. Hitchcock, having been requested at a previous meeting to present his views on some topic connected with the improvement of agriculture, read the following paper on "Farmers' Institutes:"—

Since the last time I attended a meeting of the Agricultural Board, I have had an opportunity of witnessing the operation of a Teachers' Institute, under the admirable management of the Secretary of Education, and I was impressed with the great and salutary influence which such a system must exert upon the cause of education in Massachusetts. But another thought has occurred to me. Why should we not have Farmers' Institutes, as well as Teachers' Institutes. We have agricultural chemists, scientific farmers, practical farmers, botanists, vegetable and animal physiologists, geologists, meteorologists, abundantly qualified, and, I doubt not, willing to go into the different districts of the State, and instruct the farmers there in their several departments. During the winter months, I presume that multitudes of farmers, with their families, would assemble for this purpose; nor can I doubt that their hospitality would be quite as generous as are experienced by the strangers who attend the Teachers' Institutes. By such a system the following objects would be accomplished.

1. A vast amount of knowledge concerning the principles of agriculture could be imparted to the farmers in every part of the State. It would, in fact, form an ambulatory agricultural school, where the young, especially, would learn very rapidly from the best masters.

2. It would give an opportunity to men well qualified, after looking at the chemical and geological constitution of the soil, to make suggestions to the farmers of the different districts as to improved modes of culture.

3. It would furnish a good mode of communicating intelligence to the farmers of discoveries and improvements in agriculture, of distributing new varieties of seeds, and making known new and improved breeds of domestic animals.

4. It would probably bring to light new manures in different parts of the State by the researches of the lecturers, and of the farmers after they were put upon the track.

5. It would awaken a deeper interest in agricultural pursuits, and give them increased respectability.

6. Opportunity might be given during the meetings of the Institute for visiting some of the best conducted farms and gardens in the vicinity, and thus witnessing the operations of scientific principles.

I know of but two difficulties in the way of the immediate adoption of such a plan. One is, that as yet we have no secretary to the Board, an indispensable pre-requisite. Another is, that we have no pecuniary means placed at our disposal for any purpose. The first difficulty, I trust, will soon be removed, and for getting rid of the second, I take the liberty of suggesting that a petition be presented to the Legislature, now in session, for the means requisite for establishing and putting in operation a Farmers' Institute.[1]

Secretary Flint, in his first annual report, under date of Jan. 23, 1854, said that the establishment of farmers' institutes, it was thought, would, to some extent at least, supply the wants for education in agriculture; that the Board of Agriculture had no means in their power to enable them to take any steps towards the establishment of these institutes; and that it was desirable that some provision should be made at an early day with reference to this object.

At the annual meeting of the Board, Jan. 21, 1859, Messrs. John C. Bartlett, Simon Brown and E. W. Bull were constituted a committee to consider and report upon the propriety of instituting meetings similar to teachers' institutes for the discussion of agricultural topics. On February 3 following this committee submitted a report to the Board, from which the following extract is taken: —

Public meetings, under the direction and control of the Board of Agriculture, will best subserve this purpose.

Your committee therefore recommend that the Board of Agriculture authorize a committee for each county in the State, the members resident in the county, whose duty it shall be to call a meeting of the farmers at such time and place as in their best judgment may be proper, to promote the interests of the farmer by discussions, lectures, essays, or otherwise, and who shall communicate to the Board a full report of their doings.

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[1] Agriculture of Massachusetts, 1852, p. 669.

Your committee would also recommend that these meetings be commenced as soon as possible.[1]

The above report was unanimously adopted, and the members of the Board in the various sections of the State were constituted committees accordingly.

PUBLIC MEETINGS OF THE STATE BOARD OF AGRICULTURE.

The State Board of Agriculture early conceived the idea of enlarging its usefulness by the holding of public meetings for lectures and discussions in various parts of the Commonwealth. At a meeting on Oct. 21, 1857, a committee of three was appointed to consider the subject of holding a general meeting, and to invite the farmers and the public to discuss the agricultural interests of the State.

In December, 1861, Dr. George B. Loring advanced the idea of quarterly sessions of the Board, in addition to the annual meeting in Boston, — in Worcester, in April; in Springfield, in July; in Pittsfield, in October; and that public notice of these meetings be given by the secretary, with the request that the officers of the various societies in the neighborhood of the meeting be invited to attend; and that questions for discussion be provided by a committee appointed for that purpose.

This proposition was taken up at the next meeting, in January, and a committee was appointed to consider the subject and report thereon. The report of the committee, however, was unfavorable to the project.

At a meeting of the Board, on Jan. 15, 1863, it was —

Voted, That also an annual meeting for discussions and lectures, which leading agriculturists in the county shall be invited to attend, be held at such places in the Commonwealth as the Board may designate, on the second Tuesday in December, and that a standing committee of three be appointed to make arrangements by providing lectures &c for such meeting. At this meeting any business which may come before the Board may be transacted.

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[1] Agriculture of Massachusetts, 1858 (Part I.), p. 42.

The first committee on these public winter or country meetings was constituted by the appointment of Messrs. John Brooks, George B. Loring, Marshall P. Wilder and Secretary Flint. At a meeting of the Board on February 26 this committee was instructed to propose subjects for essays at that meeting, and secure competent persons to deliver these essays, which were to be the property of the Board, and to give due notice of the programme of the meeting in the newspapers of the Commonwealth.[1]

The first of these meetings, which have continued an annual feature, was held at City Hall, Springfield, Dec. 8–11, 1863. The subject of agricultural education was discussed, the chief speakers being Prof. S. W. Johnson and Dr. George B. Loring; there was a discussion on "Soils and Agricultural Resources of Massachusetts;" Professor Johnson lectured on "The Application of Manures;" Secretary Goodale of the Maine State Board of Agriculture read a paper on "Dairying;" Secretary Flint read a paper on "Milk and Butter Making;" "Grape Culture" was discussed by E. W. Bull; "Farm Crops" were discussed; Professor Agassiz lectured on the work performed by glaciers in preparing the soil of temperate regions for cultivation; he also discussed "Cattle Breeding;" and "Sheep Husbandry" was discussed by Dr. Loring and others.

AGRICULTURAL AND HORTICULTURAL SOCIETIES, FARMERS' CLUBS, ETC.

The Hon. Marshall P. Wilder, in "An Historical Address," delivered before the Massachusetts Agricultural College on the occasion of graduating its first class, July 19, 1871, said: —

> The parent societies of agriculture and horticulture, to which we have already alluded, still live in a green old age, and are at work with us in the promotion of our good cause. These institutions were founded by men of liberal education, men who knew how to appreciate its advantages in the various

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[1] Summer or field meetings were instituted by a resolve of Feb. 3, 1868. The first of these meetings was held at the Massachusetts Agricultural College, Amherst, Aug. 4, 1869.

pursuits of life. True, they were stigmatized as "book-farmers," but to them we are indebted mainly for the harvest we are now reaping.

Lack of space will prevent giving more than the name and date of incorporation of these many societies: Massachusetts Society for Promoting Agriculture, 1792; Kennebeck Agricultural Society, 1801; Western Society of Middlesex Husbandmen, 1803; Berkshire Agricultural Society, 1811; Oxford Agricultural Society, 1812; Second Oxford Agricultural Society, Hampshire Agricultural Society, 1814; Agricultural Society in Attleborough, 1816; Agricultural Society of Maine, Hampshire, Franklin and Hampden Agricultural Society, Winthrop Agricultural Society, Worcester Agricultural Society, Essex Agricultural Society, 1818; Agricultural Society in the County of Plymouth, Somerset Agricultural Society, 1819; Farmers' Association, 1821; Bristol County Agricultural Society, 1823; Massachusetts Horticultural Society, 1829; Woburn Agricultural and Mechanic Association, 1830; Reading Agricultural and Mechanic Association, 1831; South Reading Mechanic and Agricultural Institution, Malden Agricultural and Mechanic Association, 1833; Suffolk Agricultural Society, 1839; Worcester County Horticultural Society, 1842; Hampden Agricultural Society, Barnstable County Agricultural Society, 1844; New Bedford Horticultural Society, Hampden County Horticultural Society, 1847; Housatonic Agricultural Society, 1848; Norfolk Agricultural Society, 1849; Franklin County Agricultural Society, East Hampshire Agricultural Society, 1850; Agricultural and Mechanic Hall Association, Worcester County West Agricultural Society, 1851; Fitchburg Agricultural Society, Chelmsford Agricultural Society, 1852; Middlesex South Agricultural Society, 1854; Worcester South Agricultural Society, Middlesex North Agricultural Society, 1855; Nantucket Agricultural Society, Eastern Hampden Agricultural Society, 1856; Martha's Vineyard Agricultural Society, Highland Agricultural Society, 1859; Hoosac Valley Agricultural Society, Worcester South-East Agricultural Society, 1860; and Bristol County Central Agricultural Society, 1862.

In the "Massachusetts Agricultural Repository and Journal," Vol. III., 1813, p. 67, reference is made to the Agricultural Society of East-Andover, County of Oxford; and in the same publication, Vol. IV., 1817, p. 282, to the Shrewsbury United Agricultural Society, the Newbury Agricultural Society, the Agricultural Society in Vassalborough and the Danvers Agricultural Society; but no act or date of incorporation, if incorporated, of either has been found.

The first general law relating to agricultural societies was enacted at the January session in 1819, and was entitled "An Act for the Encouragement of Agriculture and Manufactures." This law provided, under certain conditions, for the payment of State bounty not exceeding $600 to each incorporated society.

Acts of 1853, chapter 312, provided that "ten or more persons, in any county, town, or city within the State, who shall, by agreement in writing, associate for the purpose of encouraging agriculture, horticulture, or improving and ornamenting the streets and public squares of any city or town, by planting and cultivating ornamental trees therein," might, under certain conditions, associate together for said purposes.

Hon. Amasa Walker, Secretary of the Commonwealth, was one of the first to suggest the formation of farmers' clubs. In an address before the Worcester South Agricultural Society, on "The Farmers' Wants," he said: —

> Let us suggest then, as a commencement of this experiment of home education, that all the farmers in a town, desirous of improvement, should assemble together and organize themselves into an association or club, and establish a weekly meeting during the most favorable season of the year.[1]

After outlining a plan for the carrying forward of the work of such a club, he concluded his address with the following words: —

> In a few isolated cases, farmers' clubs have been formed and found successful. To complete the system, we want these small societies formed in all the towns, and the whole united

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[1] Agriculture of Massachusetts, 1855 (Part II.), pp. 336-346.

into one grand and co-operative system of popular agricultural education, under the auspices and patronage of the government of the State. Shall we have it? The farmers, especially the young farmers, of the old Bay State, must answer the question.

By chapter 203, Acts of 1859, entitled "An Act relating to Farmers' Clubs," the secretary of the State Board of Agriculture was authorized to appoint one or more suitable agents to visit various towns in the Commonwealth for certain purposes, among them being the purpose of "encouraging the establishment of farmers' clubs."

At a meeting of the Board, Nov. 29, 1859, a committee was appointed to consider what action should be taken in compliance with the above act. Later, arrangements were made to send a circular to one or more farmers in every town in the State in the interests of the project.

The following extract is from Mrs. Lucy Cutler Kellogg's "History of Bernardston" (Franklin County): —

> Among the flourishing institutions of the days past there was in Bernardston a Farmers' Club and Agricultural Library Association. This was a fully officered association, meeting weekly for discussion and study of the best methods in vogue as pertaining to farming. Members seem to have been enthusiastic, and to have enjoyed exceptional advantages in the way of having talented speakers and lecturers from those who stood high in the State as experts. It was in existence during the years 1859, '60, '61 and '62, surely, and the meetings were largely attended by the citizens and their wives.

"AGRICULTURE OF MASSACHUSETTS."

At a meeting of the State Board of Agriculture, held Jan. 25, 1853, Hon. Amasa Walker, Secretary of the Commonwealth and acting secretary of the Board, read the first annual report of the said Board to the Legislature, which was accepted and ordered to bear date Jan. 13, 1853. This report constituted the "Proceedings of the State Board of Agriculture, for the year 1852." It also contained, as an appendix, the "Laws of Massachusetts in relation to Agricultural Societies, up to May 10, 1853, inclusive."[1]

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[1] Agriculture of Massachusetts, 1852, pp. 661–783.

The first annual report of the secretary of the Board of Agriculture, the first report of Secretary Flint, bore date of Jan. 23, 1854. From the first, these volumes, published annually, have been known under the title "Agriculture of Massachusetts."

This report was published as a legislative document for some years, the first legislation on the subject found being chapter 33 of the Resolves of 1856, which authorized the clerk of the Senate to number it 4 in the series of Senate documents. Chapter 46 of the Acts of 1858 included this report in the "public" series of documents. The report was designated as Public Document, No. 4, and has so continued to the present time.

Chapter 221 of the Acts of 1860 provided that the record of the doings of the Commissioners on Contagious Diseases among Cattle, or an abstract of the same, should "be printed in the annual volume of Transactions of the State Board of Agriculture." This legislation was continued by chapter 138 of the Acts of 1862, and this has been the policy substantially to the present day.

Chapter 33 of the Resolves of 1856 authorized the clerk of the Senate to cause to be printed, annually, before the meeting of the Legislature, or as soon thereafter as possible, 10,000 copies of this report, of which 2,000 copies were to be reserved for the use of the Legislature, and the residue placed at the disposal of the secretary of the Board.

Secretary Flint, in his first annual report (1853), said: —

> Special care has been taken, to effect a general and judicious distribution of the volume of Agricultural Transactions, annually published by the State. Copies have been sent directly to the small and remote towns, many of which had no representative and no express, to men who read it with interest, and who desire to improve by the practice and experience of others. It has thus been put into the hands of very many who could not, otherwise, have obtained it without great difficulty.

These annual volumes were divided into two distinct parts, Part I. being the report of the secretary of the State Board of Agriculture, and Part II. the abstract of the returns of the agricultural societies, and miscellaneous agricultural matter. In the opening sentence of his first report Secretary Flint said that he proposed "to review the past and present condition of the agriculture of Massachusetts. The past will be found, it is thought, full of interest and instruction; the present, full of encouragement and hope." He devoted 100 pages to this review.

His reports for 1854–59, inclusive, contained information concerning the operations of the Board of Agriculture with the farm of the State Reform School at Westborough. His second report (1854) contained valuable meteorological data, giving, among other things, a history of the droughts from 1623 to 1854, inclusive. A feature of his third report (1855) was an illustrated article of 45 pages on agricultural implements and machines. His fourth report (1856) was taken up to the extent of some 230 pages with an illustrated discussion of grasses, care of grass lands, harvesting the hay crop, etc. A large portion of his fifth report (1857) was given up to an account of the State exhibition held under the direction of the Board of Agriculture at Boston in October. Sixty or more pages of his sixth report (1858) were devoted to a discussion of the Indian corn crop. His eighth report (1860) treated of pleuro-pneumonia in cattle; also sheep husbandry and horses. His ninth report (1861) devoted some 60 pages to the animals of Massachusetts, by E. A. Samuels, while his tenth report (1862) contained an account of his trip to Europe. Beginning with his eleventh report (1863), we find included in these annual volumes the lectures and discussions at the public winter meetings of the Board. This report for 1863 also contained an account of his visit to the International Exhibition at Hamburg and to the various agricultural schools and farms of Europe.

These annual volumes, issued for the years 1853–63, inclusive, contained a total of 7,284 pages of printed matter, or an average of 662 pages per volume. Col. Marshall P. Wilder, in a statement of the "History and Progress of the Board," on the occasion of its twenty-fifth anniversary, said, of these annual reports: —

And here it may be stated, that, twenty-five years ago, the agricultural literature of the country was far from being creditable to us. Most of the works of ability were reprints of English publications, and were not generally read, or adapted to our location. The Board has contributed largely to the improvement of the agricultural literature of the country, raising it to a much higher standard of merit, until it stands on a par with that of any other science.[1]

MANUAL OF AGRICULTURE.

At the third meeting of the State Board of Agriculture, held in September, 1852, Messrs. J. W. Proctor, Edward Hitchcock and Stephen Reed were appointed a committee to consider the expediency of preparing a manual on agriculture for the use of common schools. At the succeeding annual meeting of the Board, in January, 1853, this committee submitted the following report, which was accepted: —

The committee who were instructed to consider the expediency of introducing to our public schools the study of the elements of agricultural science, report: —

That studies of this description might be attended to with much benefit under competent teachers. The surprise is, that they have been omitted so long, while so many of less practical utility have been introduced.

Probably the want of text books adapted to the understandings of pupils has been one cause of this.

The committee have examined "The Progressive Farmer," by Prof. Nash,[2] of Amherst, and think it better adapted to the wants of the community, than any work of the kind that has come to our knowledge.[3]

At a meeting of the State Board of Agriculture, held in October, 1856, Messrs. John C. Bartlett, Benjamin V. French and Secretary Flint were appointed a committee to take into consideration the propriety of having a text-book on agriculture, prepared under the sanction of the Board.

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[1] Agriculture of Massachusetts, 1877 (Part I.), pp. 263, 265.

[2] Member State Board of Agriculture, 1852–55, Hampshire Agricultural Society; also, instructor of agriculture in Amherst College.

[3] Agriculture of Massachusetts, 1852, p. 669.

At the annual meeting of the Board, in 1860, it was —

Resolved, That the Committee on Agricultural Education be and hereby are authorized to prepare an elementary manual of agriculture for the use of our common schools, to be submitted to this Board for approval.

Resolved, That the said committee be requested to cause to be introduced the aforesaid manual, when approved by this Board, into the common schools of Massachusetts, in the manner provided for the introduction of school books by the laws of the Commonwealth, and that said committee be authorized to apply to the Legislature for the passage of an act for the accomplishment of this object.

At a meeting of the Board, on Jan. 10, 1861, the subject of the manual being under consideration, the Board —

Voted, That the Committee on the Manual be authorized to accept a proposition from Mr. Emerson and Mr. Flint securing to them the copyright of the Manual as a compensation for their services in preparing the book, upon such terms as to price of the work to be furnished to public schools, farmers' clubs, and agricultural associations in Massachusetts as may be agreed upon by said committee.

At a meeting of the Board, January 25, Col. Marshall P. Wilder presented the following report, which was accepted and the agreement confirmed : —

The committee appointed by the Board to negotiate with the authors of the Manual of Agriculture for the copyright of the same, report that they have attended to that duty and submit the following agreement as the result of their labors: —

BOSTON, Jan. 21, 1861.

The undersigned agree to furnish the manuscript for a Manual of Agriculture for the use of the schools on the following terms.

The cost of composition, electrotyping and illustrating of the Manual shall be paid by the Board of Agriculture of Massachusetts.

The copyright and plates of the Manual shall be held by the undersigned, under an agreement that the book shall be furnished by them to the schools, agricultural clubs, State Board of Agriculture and other agricultural associations of Massachusetts at a price only sufficient to cover cost, interest and commissions.

(Signed) GEO. B. EMERSON.
CHAS. L. FLINT.

The following resolution was unanimously adopted: —

Resolved, That this Board approve of the Manual of Agriculture submitted by its authors, Geo. B. Emerson and Charles L. Flint, and recommend its publication by those gentlemen as a work well adapted for use in the schools of Massachusetts.[1]

At a meeting of the Board, held Jan. 17, 1862, it was —

Resolved, That a committee of three consisting of Messrs. Joseph White, Charles C. Sewall and Henry H. Peters, be requested to represent the merits of the Manual of Agriculture to the committee of the Legislature on Education, on the order "To consider the expediency of including the elements of agriculture among the branches to be taught in all the public schools in which the school committee deem it expedient."

In his ninth annual report (1861), Secretary Flint said of this Manual: —

It is a work of over three hundred pages, designed for the use of the more advanced classes in the public schools, and for the use of farmers generally. It was not expected that this Manual would take the place of the elementary studies in the schools. . . . It is gratifying to be able to state, that the objects of the Board in the preparation of the Manual have been appreciated, and that many of the towns very promptly introduced it into their schools, and, so far as heard from, with uniformly satisfactory results. . . .

Hitherto the want of a suitable text-book, comprehensive in plan, simple in arrangement, and complete in execution, has presented an insuperable barrier to the successful introduction of the study of the practical sciences connected with agriculture into the common school. It was the purpose of the State Board of Agriculture to supply this want, and the Manual is offered as the means of laying the foundation of a valuable practical education.[2]

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[1] Manual of Agriculture, for the School, the Farm, and the Fireside, by George B. Emerson and Charles L. Flint. 306 pages. Illustrated. Boston, 1862.

[2] Agriculture of Massachusetts, 1861 (Part I.), pp. 196–198.

AGRICULTURAL TRACTS.

At a meeting of the State Board of Agriculture, held July 7, 1858, it was voted that a committee consisting of Messrs. Atwater, Brown and Marston be appointed to take into consideration the subject of collecting and publishing information on agricultural subjects, for distribution in pamphlet form. At the meeting of the Board in January following, this committee presented a report, which was accepted.[1] In this report it was recommended that a committee be appointed to superintend the publication of such tracts as might be approved by them under the direction of the Board, and Messrs. Atwater, Marston and Secretary Flint were constituted the committee. At a meeting held Feb. 4, 1859, it was —

Voted, To print 2,000 copies of the circular on manures; 1,000 copies of the circular on renovation of pastures; 1,500 of that on root crops; 1,000 of that on fruits; 1,000 of that on fencing; 1,000 of that on cattle husbandry; 800 of that on sheep; 200 of that on diseases of vegetation; 1,500 of that on horses; 2,000 of that on grain crops; and 500 of that on market fairs.

At a meeting of the Board, held Jan. 6, 1860, Mr. Atwater, as chairman of the committee on the preparation of tracts, presented the following report, which was accepted: —

The committee appointed to carry out a resolution of the Board of Agriculture to publish information on agriculture in tract form, report, that they have had printed an edition of forty thousand copies of an extract from the Fourth Annual Report of the Secretary of your Board on the culture of the grasses, and ask your approval of the following plan for distribution.

Grant to the members of the Legislature and the Secretary of the Board, 5,000 copies; to the members of this Board, 2,500 copies; to be sent to the teachers in our public schools, (10,000 in number) one copy to each teacher in charge of schools in cities, and four copies to other teachers, to be read publicly in schools, and loaned out from week to week, to be read in the families in the farming districts, 31,000 copies, making in all 38,500.

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[1] Agriculture of Massachusetts, 1858 (Part I.), p. 39.

The Secretary of the Board of Education, Hon. Geo. S. Boutwell, has assured your committee that the Department of Education will distribute the tracts with a circular making the request above stated, without expense to this Department if he is immediately furnished with the publications.

On motion of Professor Clark, it was voted to apply to the Legislature for the sum of $1,100 to be used in the collection of information.

At a meeting of the Board, held in December, 1860, the committee to whom was referred the consideration of preparing agricultural tracts, to be issued in connected series by the Board of Agriculture, reported unanimously that the projected publication of an agricultural manual by a committee of the Board rendered inexpedient any issue of such tracts at the present time, which report was accepted.

OTHER AGRICULTURAL PUBLICATIONS.

The object of agricultural publications is to disseminate information in agriculture. It seems proper, therefore, in this connection, to refer to certain publications relating to agriculture and kindred subjects authorized by the Legislature, and to certain other publications which appear to have been published within the Commonwealth during the period covered by this history. It is not presumed, however, that a full and complete list of such publications will be given.

PUBLISHED BY THE COMMONWEALTH.

"Manual on the Growth of the Mulberry Tree and the Culture of Silk." By Cobb. See Resolves, 1831, chapter LXXX. (January session), and Resolves, 1833, chapter XLVII. (January session).

"Reports on the Agriculture of Massachusetts." By Rev. Henry Colman. I. County of Essex, Boston, 1838. II. County of Berkshire, Boston, 1839. III. Wheat and Silk. Senate, No. 36, Boston, 1840. IV. Counties of Franklin and Middlesex, Boston, 1841. See Resolves, 1837, chapter LXVII.

"Reports on the Geology of Massachusetts." By Edward Hitchcock. See Resolves, 1831, chapter XXXIV.; 1832, chapter LXXXIII.; 1833, chapter XXXIX.; 1834, chapter XVIII.; and 1837, chapter LXXIII.

"Reports on the Fishes, Reptiles and Birds of Massachusetts." By W. B. O. Peabody and D. H. Storer. Boston, 1839. See Resolves, 1837, chapter LXVII.[1]

"Reports on the Herbaceous Plants and on the Quadrupeds of Massachusetts." By Chester Dewey and Ebenezer Emmons. Cambridge, 1840. See Resolves, 1837, chapter LXVII.[1]

"Report on the Invertebrata of Massachusetts." By Augustus A. Gould. Cambridge, 1841. See Resolves, 1837, chapter LXVII.[1]

"Report on the Insects of Massachusetts Injurious to Vegetation." By Dr. Thaddeus William Harris. Cambridge, 1841; Boston, 1852, 1862. See Resolves, 1837, chapter LXVII.; 1850, chapter 55; 1851, chapter 53; 1859, chapter 93.[1]

"Report on the Trees and Shrubs growing naturally in the Forests of Massachusetts." By George B. Emerson. Boston, 1846. See Resolves, 1837, chapter LXVII.; 1847, chapter 15.[1]

"Abstracts from Returns of Agricultural Societies." Published by the Secretary of the Commonwealth. 8 vols. Boston, 1846–53. See Acts, 1845, chapter 111.

"Agriculture of Massachusetts." Published by the secretary of the State Board of Agriculture. 11 vols. Boston, 1854–64. See Acts, 1852, chapter 142.

"Culture of the Grasses." Agricultural Tract No. 1. Published by the State Board of Agriculture. Boston, 1860.

"Statistical Information relating to Certain Branches of Industry in Massachusetts." Agriculture. By Francis DeWitt, Secretary of the Commonwealth, Boston, 1856.

TRANSACTIONS OF AGRICULTURAL SOCIETIES.

Particularly Massachusetts Society for Promoting Agriculture (Massachusetts Agricultural Repository and Journal), 1793–1827, 1858, 1859; Essex Agricultural Society, 1818–63; Norfolk Agricultural Society, 1849–63; Worcester Agricultural Society, 1843–63; and Massachusetts Horticultural Society, 1843–63.

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[1] Published by Commissioners on Zoölogical and Botanical Survey of State.

AGRICULTURAL AND HORTICULTURAL PAPERS AND MAGAZINES.

Among these we note the "Agricultural Intelligencer and Mechanic's Register;" "The New England Farmer;" "The Yankee Farmer, and New England Cultivator;" "The Boston Cultivator;" "Journal of Agriculture;" "The Illustrated New England Cultivator;" "Horticultural Register and Gardener's Magazine;" "The American Gardener's Magazine;" "American Journal of Horticulture and Florists' Companion;" and the "Magazine of Horticulture, Botany, etc." These were published in Boston.

BOOKS FOR THE TRADE.

Probably the most important among these are: "Thomas' Old Farmers' Almanack," Boston, 1791–1863; "The New England Farmer; or Georgical Dictionary," Samuel Deane, Worcester, 1797; "The American Orchardist," James Thacher, Boston, 1822; "Conversations on Vegetable Physiology," Rev. J. L. Blake, Boston, 1830; "The Sylva Americana," D. J. Browne, Boston, 1832; "The New American Orchardist," William Kenrick, Boston, 1833; "Book of Fruits," Robert Manning, Salem, 1838; "The New American Gardener," Thomas G. Fessenden, seventh edition, Boston, 1833; "An Essay on the Practicability of Cultivating the Honey Bee," Jerome V. C. Smith, Boston, 1831; "A Practical Treatise on the Management of Bees," James Thacher, Boston, 1829; "The Complete Farmer and Rural Economist," Thomas G. Fessenden, second edition, Boston, 1835; "Animal Chemistry," Justus Liebig, Cambridge, second edition, 1843; "A Practical Treatise on the Culture and Treatment of the Grape Vine," J. Fisk Allen, second edition, Boston, 1848; "European Agriculture and Rural Economy," Rev. Henry Colman, Boston, 1846; "The Fruits of America," C. M. Hovey, Boston, 1852; "The American Fruit-Book," S. W. Cole, Boston, 1857; "Milch Cows and Dairy Farming," Charles L. Flint, Boston, 1859; "The Principles of Breeding," S. L. Goodale, Boston, 1861; "The Gardener's Text-Book," Peter Adam Schenck, Boston, 1851; "Farming as it is," T. J. Pinkham, Boston, 1860; "Country Life," R. Morris Copeland, Boston, 1860; "The Farmer's Lighthouse," J. E. Kent, Boston, 1856;

"Manual of Agriculture," George B. Emerson and Charles L. Flint, Boston, 1862; and "The Field and Garden Vegetables of America," Fearing Burr, Jr., Boston, 1863.

CONCLUSION.

In concluding this paper, it is desired to call attention briefly to certain matters bearing on the subject under discussion, and which could not well be included under the several headings.

By Acts of 1839, chapter 10, certain persons were made a corporation, by the name of The Proprietors of the Botanic Garden in Boston, for the purpose of extending the knowledge and cultivation of plants, shrubs and flowers in the said city of Boston.

Bounties or other aids for the growing of hemp were offered by legislative resolves in 1786, 1787, 1789, 1790, 1791, 1792, 1848 and 1849; for the culture of silk, by legislative acts in 1835, 1836 and 1839; for sugar beets, by legislative acts in 1837; for wheat, by legislative acts in 1839 and 1840; and for a remedy for the potato rot, by legislative resolves in 1851 and acts in 1857. Resolves relating to meteorological observations were passed in 1850 and 1854. Resolves in favor of the establishment of a national board of agriculture were passed by the Legislature of 1850.

In 1842 the Legislature passed the following resolves concerning agriculture (chapter 69):—

> *Resolved*, That agriculture is entitled to the same protection from the state and general governments as is given to any other branch of industry.
>
> *Resolved*, That it is the duty of the federal government, in assessing duties on imports to supply the wants of the national treasury, to so discriminate as to afford all necessary protection to those engaged in agriculture.

In his fourth report Commissioner Colman devoted about nine pages to a general consideration of the subject "Agricultural Education," and among other things expressed the opinion that in every university there should be "a professor of agriculture, whose department should embrace every department of this great art, with the kindred sciences of botany, zoölogy and chemistry, as far as they bear upon it."

In tracing the development and growth of agricultural education in this Commonwealth, the author has sought to make the best use of the material that has come into his hands. He realizes, perhaps far more than when he began the paper, that the subject is a very large one, and that it opens up many interesting and instructive lines of inquiry. While he hopes that all available material bearing on the subject has come within his observation, still, it can hardly be presumed that such is the case. Enough has been presented, however, to show that Massachusetts has not been negligent in the matter, and that prior to 1863 much progress had been made. The discussion of the subject in full to date would make a rarely interesting and valuable volume to all who are interested in and working for the betterment of the agricultural interests of our Commonwealth.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE,

PUBLISHED IN

MASSACHUSETTS CROP REPORTS, 1906.

THE HOME GARDEN.

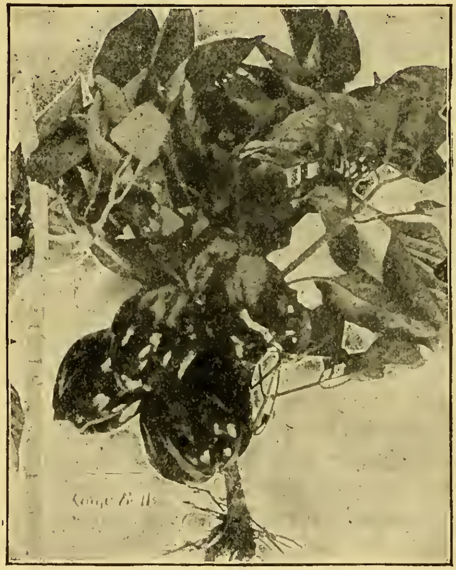
BY PROF. F. W. RANE, DEPARTMENT OF HORTICULTURE AND FORESTRY, NEW HAMPSHIRE COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

Just how to handle, plan and arrange, select best varieties, and, in a nutshell, get satisfactory results in caring for a home garden, is not an easy thing to explain satisfactorily in a brief discussion. A successful garden is the result of an apparent interest in the undertaking by the owner himself. Let us first awaken this.

To get up an interest and to get best results I would say start in early in winter, when the seedsmen's catalogues begin to appear soon after Christmas, to study them and get out the seed order. This of necessity must be preceded by a plan of the garden and the area of each crop to be grown. It is a good practice to consult a neighbor who has a reputation for having a successful garden, and get all the points we can. The commercial men who are growing on a large scale are also always of a generous disposition, and ready to give any one the information he cares most for. There is a mistaken impression, seemingly general, that large growers do not select the better varieties for use, and therefore the varieties grown by them are not the best for the home garden. From an extended experience and acquaintance with both the average person making his own garden and the commercial grower, I am convinced that the varieties grown by the latter are far superior. The commercial man is constantly studying the problem of varieties, and it is a part of his life's work to take advantage of any improvements as soon as they are proven valuable. Neither is he led astray by the too frequent fake novelties commonly grown by many novice gardeners. Some of the State experiment stations make a very close study of vegetable growing as a part of their horticultural work, and are ever ready to suggest what they consider the best lists of varieties for planting, and to pass judgment upon new things which they have tested. Bulletins are available, either from the State experiment stations or from the United States Department of Agriculture, that have been written to assist such of us as care to make a garden. Without looking the matter up, I can recall many bulletins that briefly and in a practical way give just the information desired in growing certain crops. Some of those sent free by the United States Department of Agriculture, Washington, D. C., called Farmers' bulletins, are:

No. 94, "The Vegetable Garden;" No. 61, "Asparagus Culture;" No. 148, "Celery Culture;" No. 154, "The Home Fruit Garden;" No. 39, "Onion Culture;" and at the New Hampshire Station, Durham; Bulletin No. 99, "A Selected List of Vegetables for the Garden;" No. 86, "Growing Watermelons in the North;" No. 74, "Growing Strawberries in New England;" No. 52, "Growing Muskmelons in New England," etc. Many similar bulletins are likewise to be had from the Massachusetts Experiment Station at Amherst, for the asking.

With this as a start, we should be well fortified for making a success with our garden. After reading, thinking over and digesting as much as we can, we are prepared, with seed ordered and on hand, to proceed. In order to cover the ground and touch on the more important matters, let us discuss each step in order, as far as possible.

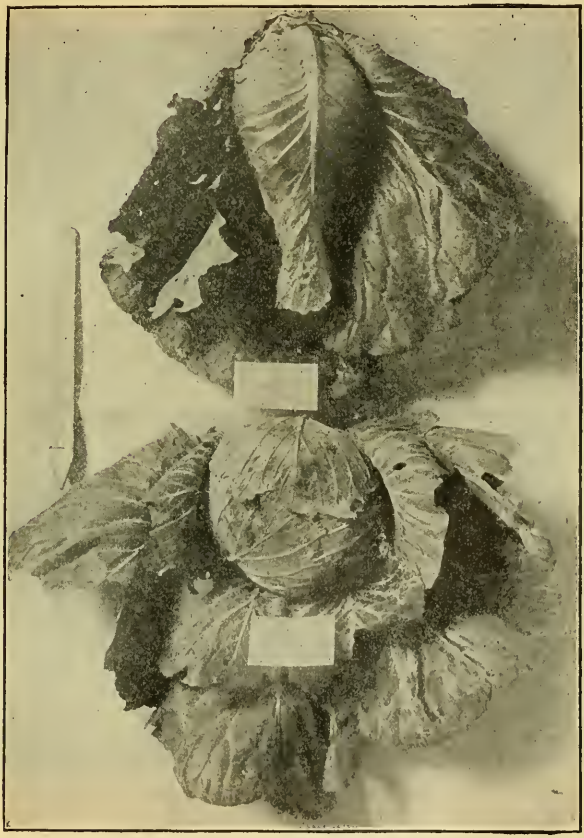


Large Bell Pepper.

I. *Fall Plowing.* — After frost has come in the fall, rake together and clean up all dead vines, cabbage stumps, etc., and throw them upon the compost heap; then plow up the ground fairly deep, and allow the furrows to remain on edge over winter. Freezing and thawing, with free access of air to the soil, are beneficial, and assist in destroying insects. In the spring such soils dry out early, and are more quickly put in condition for planting.

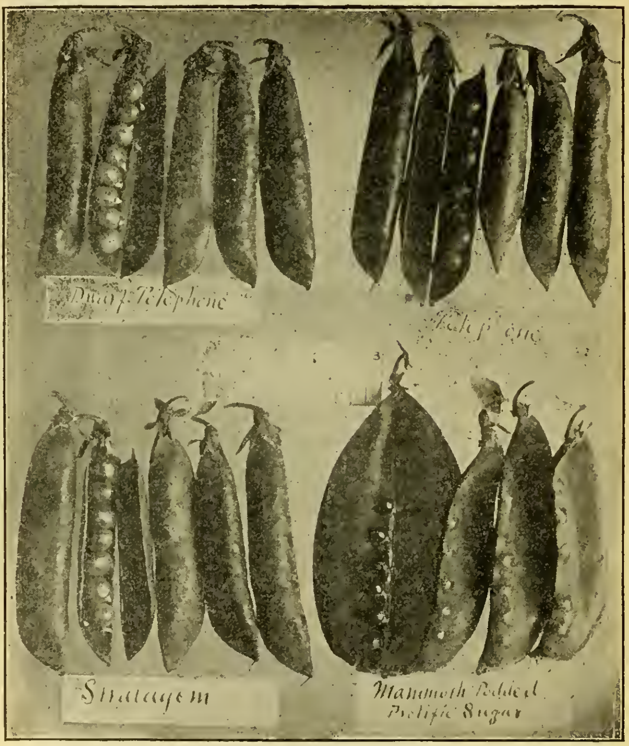
II. *Plant Food.* — The keynote for success with the home garden is this question of feeding the plants. We do not expect to get results from unfed animals; neither shall we get much pleasure in gardening unless we make the conditions necessary for good results. Let us take the time to visit some of the large gardeners about Arlington, Belmont, etc., and get an idea of how they feed plants; and if we follow their example, the most essential problem in succeeding in the home garden will have been solved. Stable and barn manures are the best fertilizers at all times. Commercial fertilizers are all right in their place and when used by persons who are experienced in such use, but call upon them when you are more experienced, and have your soil in a high degree of fertility. If you haven't enough manure for one-half acre, better cut your area down to one-fourth acre, for you will get better and more satisfactory results.

In the fall plowing turn under a good heavy application of manure, and then in the spring after preparing a good seed bed use plenty of well-rotted manure in the furrows or hills. We can just as well get two crops off the land as one, if the rotations are properly planned. Failure to succeed with gardening is due more to lack of plenty of good manure than any other one thing. We cannot get something from nothing; spend more money on manures. After putting on what you think is enough, double the amount.



Winningstadt Cabbage; Early Spring Cabbage.

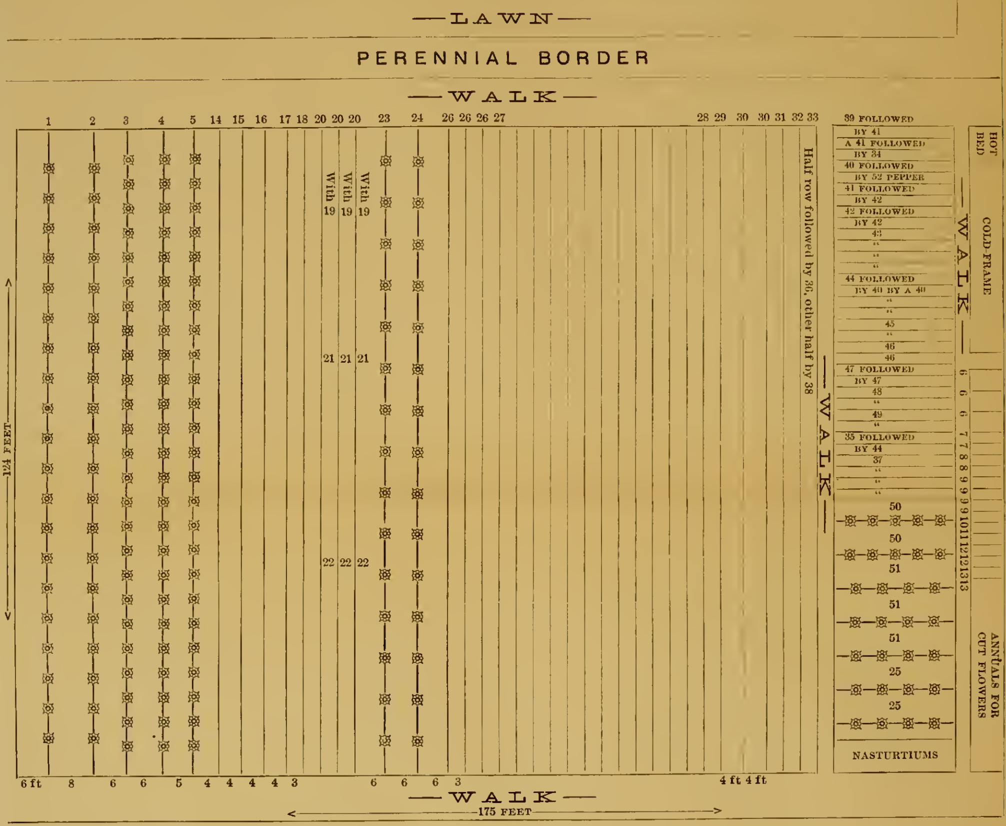
III. *Cultivation.* — The garden should be kept in a high state of cultivation throughout the season. Cultivation keeps the soil in ideal physical condition for plants to grow in, and it keeps the weeds in check. Begin cultivation as early as possible in the season, and persistently keep ahead of the weeds. The great good, among other things, to come from transplanting crops like cabbage, lettuce, onions, etc., is in being able to cultivate the ground longer and have the weeds well under subjection by the time these crops are set out. By germinating the weed seeds and then quickly destroying them by frequent cultivation early in the growing season, much labor in weed-killing can be saved later.



Varieties of Main Crop Peas.

The old-fashioned method of growing vegetables in beds, thus necessitating so much hand-weeding and back-aching work, should be eliminated by planting in long rows, so that most of the work can be done with the horse. Fencing the garden in is not practised as often as formerly. It is a better policy to be prepared to fence in the poultry and farm animals when they are likely to be troublesome, and allow the garden freedom from the grass and weedy condition almost always present in and about a fence that surrounds the garden. Plant in

PLAN OF KITCHEN GARDEN


LAWN
PERENNIAL BORDER
WALK
1 2 3 4 5 14 15 16 17 18 20 20 20 23 24 26 26 26 27 28 29 30 30 31 32 33
With 19
With 19
With 19
21 21 21
22 22 22
Half row followed by 36, other half by 38
124 FEET
6 ft 8 6 6 5 4 4 4 4 3 6 6 6 3 4 ft 4 ft
WALK
175 FEET
39 FOLLOWED BY 41
A 41 FOLLOWED BY 34
40 FOLLOWED BY 52 PEPPER
41 FOLLOWED BY 42
42 FOLLOWED BY 42
43
44 FOLLOWED BY 40 BY A 40
45
46
46
47 FOLLOWED BY 47
48
49
35 FOLLOWED BY 44
37
50
50
51
51
51
25
25
NASTURTIUMS
HOT BED
COLD-FRAME
WALK
6 6 6 7 7 8 8 9 9 9 9 10 11 12 12 13 13
ANNUALS FOR CUT FLOWERS

LIST OF PLANTS

		No. of Plants
1	Blackberries	20
2	Raspberries, blackcaps	20
3	" red	25
4	Currants	25
5	Gooseberries	6
6	Rhubarb	24
7	Mint	24
8	Thyme	24
9	Sage	24
10	Summer savory	24
11	Basil	24
12	Parsley	24
13	Horseradish	24
14	Asparagus	75
15	New strawberry bed	100
16	Old " "	

LIST OF SEEDS

		Amount of Seed
17	Bean bush lima	1 qt.
18	" dwarf h'rtic'lt'ral	1 qt.
19	" wax	1 qt.
20	Corn, cory	1 pt.
21	" black Mexican	1 pt.
22	" stowels ev'rgreen	1 pt.
23	Squash (each)	1 pkt.
24	Muskmelon (variety)	1 pkt.
25	Watermelon	1 pkt.
26	Potato, early	½ bu.
27	" late	2 bu.
28	Sweet peas	1 qt.
29	Celery	1 pkt.

		Amount of Seed
30	Tomato	1 pkt.
31	Late peas	1 qt.
32	Medium peas	2 qts.
33	Early peas	1 qt.
34	Egg plant	1 pkt.
35	Early cabbage	1 pkt.
36	Late cabbage	1 pkt.
37	Cauliflower	1 pkt.
38	Brussels sprouts	1 pkt.
39	Radish	1 oz.
40	Lettuce	1 pkt.
A41	Early turnip	1 pkt.
A40	Late "	1 pkt.

		Amount of Seed
41	Beet	1 pkt.
42	Carrot	1 pkt.
43	Onion sets	12 qts.
44	Spinach	2 oz.
45	Salsify	1 pkt.
46	Parsnip	1 pkt.
47	Kohl-rabi	1 pkt.
48	Kale	1 pkt.
49	Okra	1 pkt.
50	Bush squash	1 pkt.
51	Cucumber	1 pkt.
52	Pepper	1 pkt.

BY CLARENCE FOWLER OF THE NEW HAMPSHIRE COLLEGE

SCALE 1-2" = 12'

long, straight rows, and have plenty of room at either end to turn the horse around with ease when cultivating, planting, etc. Less room is needed where hand implements are used, but the same principles apply.

If you do not care to plant the whole row to one kind of vegetable, simply complete it with another requiring similar culture and maturity.

Above all things, keep the garden free from weeds. A small garden well tilled is far better than a large one given less care.

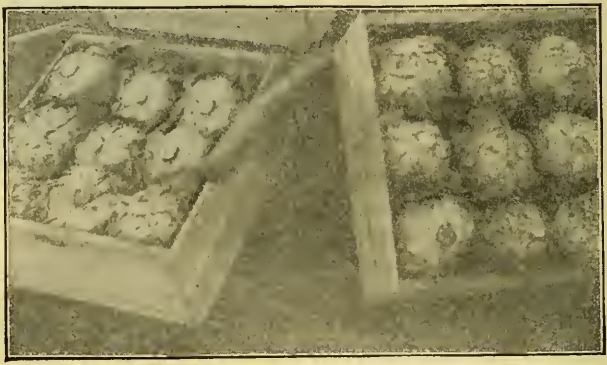
The Gradus Pea.

IV. *Garden Implements* (*Tools*). — A good set of garden tools makes the work easier, and it is poor economy not to have the best. No matter if the garden is only a quarter of an acre, to get best results the following implements are suggested for use. Plow; cutaway or disk harrow; Acme or steel-toothed harrow; steel rake; seed drill; cultivators; combination hand wheel hoe; also a good spade, spading fork, hoes, dibbers, markers, wheel-barrow, garden line, etc. The Iron Age or Planet Junior garden tools, both hand and horse, for sale by most implement dealers, should be in almost constant use.

The soil for a garden should be plowed deeply and evenly. Either the cutaway or disk harrow, both deep-cutting implements, is then put on, and in many instances either one can almost take the place of a plow. Following these come the Acme or steel-toothed harrow, which breaks up and mellows the soil, making a fine seed bed. The garden is now raked over, marked out and planted. From now on keep the surface of the soil light and all weeds down. If the rows are indicated, cultivation may begin even before the plants appear above ground. The modern wheel hoe, with its various ingenious attachments, is a great labor saver. The weeder attachments are very effective in combating small weeds when the crop is just starting. The wheel hoe can be used to hoe both sides of one row, or between the rows in level culture. It will also throw the soil either to or from the row. This tool, alone, cheapens garden making a great deal, especially lightening the unpleasant task of weeding. Plant the rows far enough apart, as shown in the accompanying garden plan, to do the cultivation with horse power. The Horse-Hoe and Cultivator is a very good cultivator. It can be adjusted to varying depths and widths, which is an advantage at times. The Steel Diamond-toothed Cultivator is a fine implement for level and fine culture.

It is not entirely the question of having all kinds of implements so much as it is in having enough and using them judiciously. Plan to go over the garden at least twice a week during the growing season.

V. *Planting.* — After the garden has been well enriched and made an ideal seed bed by thorough tillage and preparation, we are ready to plant it. The plan has been well worked out, and all that is necessary now is to plant each variety at the proper time and in its place. Every garden maker will vary plans to suit his needs, as no two will agree as to the amount and kinds of vegetables or small fruits they will grow. A very good plan is the accompanying one by Mr. Clarence Fowler, a former student at the New Hampshire College. It is quite complete, perhaps more so than many would care to follow, but has the good features desired in a plan. The short rows at one end are utilized for those crops requiring frequent plantings in order to have a succession, and not desired in large quantities.



Big Boston Lettuce.

The time to plant varies with the locality. The experience of those who have lived in the community for some time will be of value in determining this point. The dates differ more or less with the seasons. As a rule, all of the hardy vegetables for the vicinity of Boston should be planted by April 20, and the tender varieties from May 10 to June 1. Tender plants, like tomatoes, should be set by June 1. Egg plants had best be kept in the frame or greenhouse a week later before transplanting.

As well as I can determine, the best time for planting various vegetables in the vicinity of Boston is as follows: —

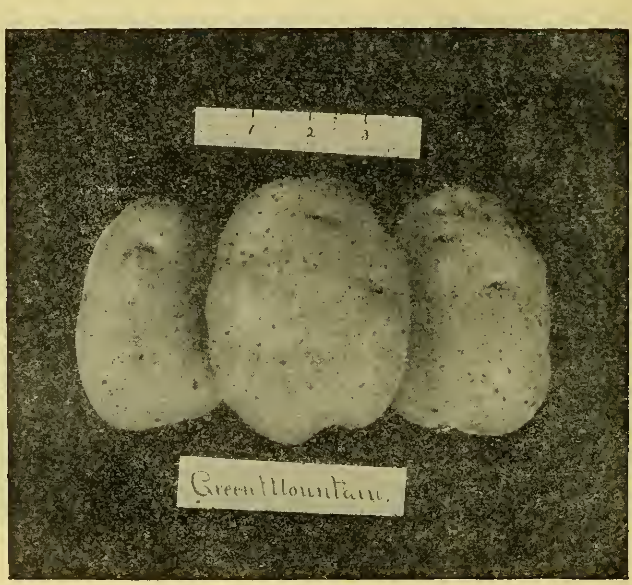
Asparagus, end of April; *Bush Beans*, first week in May; *Pole Beans*, middle to last of May; *Lima Beans*, June 1; *Beets*, middle of April; *Cabbage*, set out last week in April or first in May; *Carrots*, last of May; *Cauliflower*, May 1 to July 1; *Celery*, early, April 1, late, July; *Sweet Corn*, May 1; *Cucumbers*, May 10; *Egg Plants*, in hotbed, March 15; *Peas*, last of April to May 1; *Radishes*, April 1 to June 15; *Spinach*, September 1; *Tomatoes*, plants out of doors, May 25; *Turnips*, for fall use, July 1 to August 20; *Melons*, May 15; *Squash*, May 15; *Potatoes*, May 1.

VI. *Rotations.* — With the garden well enriched, it should be our aim to produce all we can from it. By studying out the approximate time it takes various crops to mature, and thus planning for other crops to take their places, two or more crops can be raised upon the same ground. A few crops that require the whole season to mature in are: *Long Blood Beets*, *Egg Plants*, *Watermelons*, *Onions*, *Peppers*, *Winter Squash* and *Tomatoes*. Other vegetables mature more quickly; for example: *String Beans*, 50 to 60 days; *Lettuce*, *Turnip Beets*, *Summer Squash* and *Turnips*, in about 65 days. *Corn*, *Early Cabbage* and *Cauliflower* require somewhat more time, while *Radishes* can be grown in about one-half the time. By starting many vegetables in the hotbed or cold frame, and growing them in trays, pots, tin cans, old strawberry boxes, etc., and thus being ready to set the partially grown plant in its permanent quarters, much time can be saved and thus an extra crop obtained. *Lettuce*, *Cabbages*, *Beets*, *Onions*, *Muskmelons*, *Cauliflower* and *Celery*, during a large portion of their period of development can be confined to a limited space and then finally transplanted to their permanent places to mature. By so doing we not only get more crops off a given area, but we are able to keep the soil in better condition for the plants themselves. As soon as one crop is taken out, the soil should be put

WARTED HUBBARD SQUASH.

in fine condition for the next plants to go in. Weeds are largely eliminated by this practice.

VII. *Varieties.* — It is not an easy matter to say just which one or two varieties are the best vegetables to plant, when there are upwards of a hundred or more varieties of each kind. In offering the following list, therefore, it is given only as suggestive. No one can make a mistake in growing at least the following varieties, as they stand well up at the head of the list. These results are from our experience in growing large numbers of vegetables at the New Hampshire Experiment Station each year.



Green Mountain Potato.

Bush Beans. — Giant Stringless Green Pod, Valentine, and Wardwell's Kidney Wax; *Bush Lima Beans,* — Henderson's or Sieva; *Beets,* — Eclipse or Crosby's Egyptian; *Early Cabbage,* — Early Spring and Winningstadt; *Late Cabbage,* — Succession and Lupton; *Carrots,* — Danvers Half Long and Chantenay; *Cauliflower,* — Snowball and Erfurt; *Celery,* — for early use, Golden Self-blanching; for fall and early winter, Boston Market; for winter, Pascal; *Sweet Corn,* — for very early, Early Cory; second early, Crosby's Early; medium or late, Potter's Excelsior or Squantum; *Cucumbers,* — White Spine; *Egg Plants,* — New York Improved Large Purple; *Lettuce,* — Big Boston, New York, Grand Rapids; *Muskmelons,* — Emerald Gem, Rocky Ford, Montreal; *Watermelons,* — Cole's Early, Boss, Black-eyed Susan; *Onions,* — Yellow Danvers; *Parsnips,* — Hollow

Crown; *Peas*, — early, Gradus or Prosperity, Nott's Excelsior; late, Telephone; Stratagem, dwarf and tall; *Peppers*, — Sweet Mountain, Large Bell, Improved Thick Long Red; *Potatoes*, — Early Rose, Delaware, Green Mountain, Washington; *Pumpkins*, — Small Sugar, Golden Oblong; *Radishes*, — Early Scarlet Globe, French Breakfast, Woods' Early Frame; *Squash*, — Early Prolific Marrow, Essex Hybrid, Warren, Hubbard; *Tomatoes*, — Earliana, Dwarf Champion, Stone; *Turnips*, — Early Milan, Early Snowball, White Egg, Red-top Globe; *Swedes or Ruta-bagas*, — American Purple Top Ruta-baga.

SOME CAUSES AFFECTING THE PROFITS OF DAIRYING.

BY PROF. F. S. COOLEY, PROFESSOR OF ANIMAL HUSBANDRY AND DAIRYING, MASSACHUSETTS AGRICULTURAL COLLEGE.

It is hardly necessary to assert that dairymen are deriving less profit from their investments and lower wages for their labor than they would like, or even than that which a good business should lead its patrons to expect. The purpose of this paper is to notice briefly a few of the things that stand in the way of the best success of dairy farmers. We shall consider only those concerning the producing end of the business, not because these are of greater importance than those affecting the marketing end, but because the remedies are in the main simpler and more under the control of dairymen.

It will be generally conceded that capital invested in agriculture yields smaller returns, and that farm labor is poorer paid, than capital and labor employed in manufacture or commerce. Is this disproportion due to conditions inherent in husbandry, or is it the result of a lack of intelligent efforts, poor business methods and failure of dairymen to master their business? Will not the same degree of skill and intelligence expended in agriculture command equal compensation here as in other pursuits? Occasional instances of marked success appear to indicate that it will. Indeed, the speculative element is more largely eliminated, values are more stable and dividends are more certain than in the majority of business.

The Kind of Cows kept.

One of the most important factors in profitable dairying is good cows. These should be adapted to the particular business and conditions of each dairy farm. No single breed or type meets all conditions, else what need of such diversity of size, conformation and quality of product. To be specific, for butter and cream production it is probable that the cost of production will be less and the profits therefor greater where cows yielding milk with a rather high percentage of fat are kept. Such cows produce relatively less of the milk solids not fat, and hence turn a larger proportion of their food and energy into the particular product desired, than those yielding a large quantity of milk poor in fat. This accounts for the general popularity of Jersey and Guernsey blood for butter-producing herds. Again, on a rugged New England pasture, where feed does not grow luxuriantly, large areas must be traversed and industrious efforts expended to secure the necessary food. A big, coarse, slow-moving cow would be at a disadvantage, while a small, close-built, active animal would be in its element. On the other hand, in rich meadows and in stables under high pressure the tables would be turned. This suggests where the Ayrshire and the Holstein types may be placed to the best advantage. But, after all, mistakes in these particulars are less common than mistakes in selecting good individuals.

Some very interesting results have been obtained in a canvass of certain creamery districts in the State of Vermont, and published as a cow census of that State. These results have been very ably discussed in recent publications of the Vermont Experiment Station, and show not only the wide difference in product between different herds, but also some of the causes contributing to the variation. I have not the figures before me as I write; but my memory tells me that the poorest herds averaged about 80 pounds of butter fat per cow per year, worth $20. The best herd averaged in the same time nearly 300 pounds of fat, worth $75, nearly four times the product of the poorest cows. It is easy to believe that cream production was more profitable to the owner of the best herd.

Bulletin No. 20 of the Storrs Experiment Station illustrates the principle and brings the truth home in a very convincing manner. Twenty-five cows were observed for one year, the food consumed and the products noted. The cost of feed varied between $32.36 and $48.80, or one cow ate two-thirds as much as the other. The butter product varied between 165 pounds and 509 pounds. It so happened that the cow consuming the least food produced the smallest quantity of butter. If the smallest butter product paid for the food consumed, the consumption of $16.44 worth of additional food produced 344 pounds of butter, which would make the cost per pound of the additional amount 4¾ cents. If the first cow paid for her keep, the other yielded a profit of $55. A herd of 20 cows like the latter would pay for all the farm products and food consumed, and yield an annual profit of more than $1,000. While it is the cows that eat the most, as a rule, that produce the largest products and greatest profits, the difference in consumption is much less than in production. Among this same herd of 25 cows the third cow in butter product, with 360 pounds, consumed $40.60 worth of feed; and the twenty-third in butter product, with 276 pounds, consumed $46.21 in feed, — almost as much as the best butter producer. The average cost of feed and amount of product of the best 5 and poorest 5 are as follows: —

	Cost of Feed per Cow.	Pounds of Butter per Cow.
Best 5,	$42 57	410
Poorest 5,	38 72	221
Difference,	3 85	189
Difference per cent,	9	46

Average profit, best 5,	$31 30
Average profit, poorest 5,	97
Difference per cent between poorest and best,	32.22

In the Kansas Experiment Station Bulletin No. 125 it was observed that the average cow produced a butter income of $9.62, this having been computed from statistics of an average of 626,000 cows per year for ten years. A study of results for 82 herds in the best creamery section showed an average annual income per cow (generally including a calf worth $8 to $12) of $32.86. The best 5 herds, where calves were valued at $8 apiece, averaged $45.13; while the poorest 5 herds, where calves were valued at $12, averaged $23.59, — the best herds producing twice as much as the poorest.

It is futile to continue the examination of evidence in favor of better cows. The owner of the best is constantly seeking to improve his herd. He is alert to secure better animals and increase his profits. He reads all the published information he can get, and is alive to all his needs. The owner of poor cows, on the contrary, is in ignorance of the fact, doesn't believe other cows would "do better on his feed," and has no ambition to inform himself in regard to his business or improve his conditions.

The Way Discarded Cows are replaced.

We have submitted evidence of a truth which few people doubt, — that some cows are far more profitable than others. The problem is, how to get these better cows. Among those who make dairying an important business, and pursue its practices intensively, the town and city milk producers occupy a prominent position. It is a common condition among these that their capacity to care for dairy animals is limited to cows actually in milk, or at least to those milking during the greater part of the year. Not possessing facilities for rearing the heifers to replenish their herds, they depend upon purchase for fresh cows. The purchase of milch cows, even by those best qualified to select, is attended by more or less risk of disappointment. Cows are commonly sold for a reason. Among the reasons for sale may be mentioned old age; lack of constitution, or capacity to stand feed; bad habits, such as kicking or restiveness, sucking or holding up milk; garget, resulting in defective udders; short teats; hard milkers; abortion or other disorders. The majority of cows offered for sale by dairymen who are breeders are the culls of their herds. Dairymen who depend upon purchase for their cows realize this to a certain extent, as they very keenly realize the difference between good and poor dairy animals, and are eager to secure the best, even at prices two or three times greater than common stuff brings. It is unfortunate that breeders do not realize this as fully as they should, and we are inclined to blame them for rearing so large a percentage of low-grade stock; but the fault is not theirs alone. City dairymen do not buy direct of the breeders, thus informing them of their needs; they depend rather upon middlemen and dealers. The dealers have pursued a short-sighted policy, keeping breeders in ignorance of the market value of the best cows. Often they take three or four common ones to secure one that is choice, paying a level price for the lot, or rating them at a nominal difference. The breeder, therefore, does not know what the best cows will sell for to the city milkman, and does not think how much more profitable it would be to breed and rear that kind.

Again, realizing or not realizing the difference in value, he does not employ methods calculated to produce the best results in breeding. Upon one farm heifer calves are nearly all reared, good, bad and indifferent alike; upon another they are all destroyed, without regard to dairy promise. If some sort of an exchange could be arranged, whereby the farmer with the taste and facilities for rearing heifers could secure the best of his neighbors or the city dairyman in place of the weedy ones born on his own farm, how much better results could be obtained. This is an idea that has already taken root, and is gaining favor among many engaged in the business.

More than this exchange is necessary, however, to satisfy the needs of the trade, — a system of selection needs to be observed. The laws of heredity control the dairy function as fully as they do other characters. Beef habits do not predispose offspring to produce milk. To secure superlative dairy heifers, one must lay the foundations in ancestry excelling in the desired direction. The best success, therefore, involves the careful study of the dairy qualities of the dams and grand-dams of the heifer calves we propose to rear. Superior excellence of ancestry in the qualities sought is the best guarantee of the same qualities in the progeny. In this connection, while I regard the actual production of a cow as the best evidence of her own ability to produce and transmit to her offspring, I do not disregard conformation, general appearance and type. There have been cows with great records which did not transmit the ability to come anywhere near these records in their progeny. There have been cows, on the other hand, not great milkers themselves, whose offspring have yielded large amounts. I regard the type and conformation of a cow of equal value with her actual performance in determining the value of her heifer calves for the dairy. I would not reject the progeny of a well-bred, typical cow even though her own product was somewhat unsatisfactory; nor would I certainly accept that of a large milker whose shape was so faulty as to render transmission doubtful. The cow is of less consequence in determining the dairy qualities of heifer calves than the bull. While we may, by careful selection of cows, maintain a uniformly high standard of excellence in our herds, most of the real improvement must come by mating them with the right kind of a sire. I have observed over and over again the qualities of a cow, the shape of her udder, her temperament, her conformation, and numerous little individual peculiarities, to be close reproductions of the same characters in the dam of her sire. Breeders do not realize as they should the value of a superior bull; they are often careless and indifferent in his selection. The possibilities for improvement or injury do not occur to them. Or, if in a general way farmers concede the advantage of a choice bull over a common one, they tremendously underrate it. If this idea were expressed in dollars and cents, perhaps its reality would be more impressive.

A common bull in four years' time in a 20-cow dairy begets 80 calves. If of this number 25 are reared to maturity, possessing the common qualities of their parentage, and are worth a common price, say $32 each, they represent a value of $800. Without attempting to determine at this time whether cows can be profitably reared to maturity for $32 each, let us observe what would be the value of the progeny of a superior sire. On the same basis of reproduction, and with the same number of heifers reared, but with the choice progeny of superior stock, we may reasonably expect a value of $50 each. Instead of an $800 aggregate, we have $1,250, — a difference of $450, without increasing the cost of production a penny. If we go still further, and produce a grade of heifers worth $75 each at maturity; if we use our choice prepotent sire more freely, and secure the best of his progeny from our neighbors' cows, and rear not 25 but 50 or 100 heifers, his value becomes not $450 greater than that of the scrub, but $1,075, $2,150 or $4,200. Not only will the use of a choice bull and the rearing of $75 cows be more profitable than common breeding, but it will reflect on all our business. We shall be more interested, nay, even enthusiastic; the drudgery of farming will disappear. Instead of teasing buyers to take our common stuff off our hands at a loss, we shall see them eagerly persuading us to part with them by tempting offers. How easy it is to sell what people want ! How hard to dispose of that for which there is no demand !

Feeding.

The economical feeding of cows is a large subject in itself, and can barely be mentioned in a short paper of this kind. The two points of kind and amount of foods to be used belong to the topic. As to kind in general, feeds should be produced upon the farm as largely as possible, and purchased feeds should be selected to supplement the home-grown supply. Usually this means the purchase of feeds rich in protein, paying little attention to the carbonaceous sorts on the market. In buying, three factors are to be considered: the composition and digestibility, the suitability to feeding milch cows, and the price.

The amounts fed depend upon conditions on the farm, and should be settled upon economic principles. The laws of increasing and diminishing returns are operative here, as in most lines of agricultural production. To state this principle in another way, it is evident that cows fed on starvation rations yield no product, and therefore the little food they do consume is wasted, with a minimum profit. On the other hand, by greatly over-feeding with expensive fodders wastefulness and loss are incurred. Somewhere between these two extremes is a point where the food consumed yields the greatest product per unit, or each unit of product is obtained at the lowest cost, and therefore at the greatest profit. It is the feeder's business to learn where this point is. It would be nearer to the high limit in towns, where products were high priced, than in remote country districts, far from markets. In general, feeding cows to half capacity, like working mills and factories on half time, is less profitable than when at full producing capacity.

Condimental Feeds. — The general use of condimental feeds acts adversely on the profits of the dairy. Considered as feeds, these preparations are sold at prices out of all proportion to their value. Mixtures of bran, middlings, corn, linseed, salt, etc., selling at from 10 cents to 25 cents per pound, when their feeding value is in no case more than 2 cents, is ridiculous. Considered as medicines, their use is pernicious. The healthy animal needs no medicine; the sick animal needs to be treated specifically, and not with a general shot-gun mixture, — a panacea for all the ills to which flesh is heir. The claims made by manufacturers of these condiments would be quickly discredited as preposterous if made by candid people of your acquaintance. It is not expected that these words will deter any from the use of condimental feeds or patent medicines. Men dearly "love to be humbugged," and will scarcely forego the pleasure it gives for mere financial reasons, which are the chief ones against the use of condimental feeds.

Variations in Quality of Milk.

It is well understood that milk varies in its percentage composition as regards solids, particularly in the fat content. Many of the causes of this variation are also well known.

Breed. — Jersey and Guernsey cows yield richer milk than Holsteins and Ayrshires.

Lactation Period. — Milk from cows soon after calving is poorer in fat than in the middle of the lactation period. As cows approach the time of freshening, milk grows richer and is generally richest in fat just before they dry off, when the amount secreted is small.

Individual. — Each cow has a normal fat content in her milk, which she very persistently maintains, subject to the variation caused by different stages of lactation. Between different individuals in the same herd, the same breed and different breeds is a variation amounting sometimes to the difference between less than 3 and more than 7 per cent fat. In general, the richest milk is produced in the smallest quantity, and poor quality is compensated by a large flow.

Colostrum. — The first milk after parturition differs from true milk in containing double the solids and ash, a large part of the former being albumen. It is not, therefore, like true milk, nor adapted to the same purposes of use; but is more like eggs, and particularly rich in nutrients suited to the early feeding of the calf. It should be remembered, when feeding it in place of skim milk, that one quart of colostrum is about equal to four quarts of skim milk, and its use be governed accordingly.

Feed. — The kind and amount of food consumed by cows exerts less influence upon the fat content of milk than farmers are wont to suppose. Thousands of actual determinations of fat have confirmed this truth. A prominent reason why farmers do not accept this result is, that they observe things from a different point of view; they never have determined actual fat, hence are not qualified to judge of its variation; they have merely observed the color and the "amount of cream." Scientific people never base their determinations of quality upon cream, which is far more variable and elusive than milk itself.

First and Last Milk. — Determinations indicate that the fat content of first or "fore" milk is about 2 per cent, while the "strippings" or last milk tests 8 to 10 per cent. Farmers are generally aware that a difference exists, but do not appreciate its importance. It is right here that the whole subject of quality, so far as this paper is concerned, centres. Many losses occur through ignorance of this point, which may be best illustrated by concrete examples.

A. — A young man entered a fine Devon cow in a butter-fat producing contest at a fair. The award was to be based upon the actual fat found in twenty-four hours' milk, weighed and determined by the Babcock test. From appearances this Devon cow was a certain winner. So confident was her owner that he milked her quickly each time, and gave himself little apparent concern over the results. A competitor with a good grade Jersey, not so confident, but determined to go the limit, milked his cow, and then kneaded her udder and stripped and stripped, until he could get no more. He secured a $25 prize by 2 ounces of fat over the Devon. Had the owner of the latter put his pride in his pocket, and done about fifteen minutes stripping, he would probably have been repaid at the rate of $100 per hour for his time.

B. — Some people producing cream and veal from the same cows were wont to milk the herd partially, and let the calves finish. Had they reversed the order, both the veal and the cream products would have been more satisfactory.

C. — Mr. Brown keeps a mixed farm, where his men do the field work between 7 and 6 o'clock, and the chores, including milking, before breakfast and after supper. Being eager to get to the village in the evening, they hurry through milking, leaving an average of 1 pound of milk in the udders of the 20 cows. Having been out the evening before, they rise late in the morning, again leaving the strippings. Forty pounds of milk with 8 per cent fat at 30 cents per pound would be worth about $1, which will pay for six hours' labor. Two minutes on each cow, or less than one hour, would have saved this amount; carried through the year, it would reduce the profits of the herd by $350.

D. — The Chicago milk inspectors, in their zeal to perform their duty to the city, not only tested the milk, but, to prevent any jobbery, sent their own men to milk the cows and take the samples. As a result, nearly half the cows fell below the city standard, and the fact was widely advertised by its press. The owners of these cows were not slow to announce later that after the inspector's milkers had left they milked out from 1 to 5 pounds from each cow. From the inexperience of the milkers, or their unfamiliarity with the cows, the latter had "held up" their milk. The milk they didn't get tested 6 to 8 per cent fat. The net result was to leave the public in ignorance of the real truth concerning the quality of these cows.

Anything which causes the cow to withhold the last milk reduces the fat per cent. Flies, excitement, strange milkers, roughness, scamp work, etc., which prevent the withdrawal of the whole secretion, reduce the amount, much more the quality, and therefore the profits of dairying. The most important part of milking is to *get it all*. No doubt the profits in many dairies are lessened hundreds of dollars a year through failure to do this.

Know the Cows. — A breeder and cream producer found that 10 two-year-old heifers during their first year in milk had yielded a profit over the cost of food consumed of $118. He would have been well satisfied had not the individual records of these heifers been kept. A computation of the daily weighings of milk and monthly Babcock tests revealed the fact that 4 of these 10 heifers had been kept at a loss of $29. This breeder was therefore chagrined to think that two-fifths of his labor had been spent for nothing, for had he disposed of the 4 and done only three-fifths the work his profit would have been $157 on the 6. This incident illustrates the point that an account with the whole herd is inadequate to the dairyman's needs. To prevent the contingency of keeping one, two or more unprofitable cows, he must have information of the product of each member of the herd. I believe that here is the most important factor in the profits of dairying, so far as production is concerned. If dairymen would weed out one-third of their herds by this plan, lightening their labors by that fraction, their aggregate profits from the sale of dairy products would be greater. They would have a surplus of forage to sell; and prices would advance, thus favorably affecting the financial advantages in three ways at once. But how can this be done?

MILK TEST ASSOCIATIONS.

The weighing and recording of individual milk yields is well within the abilities of the dairymen. The expense for spring balances and milk scores need not exceed $4 for an indefinite period, — five or ten years. If one would not weigh daily, results obtained by a three days' record for each month, and the sum multiplied by ten, has been found to approximate very closely to actual daily weighing.

But the use of the Babcock test on farms is less easy and practicable, and the solution must be found in co-operation. First in Denmark, then in Canada, and afterwards in the United States, communities of dairymen have clubbed together and employed an expert to test their cows. Any bright young man with a dairy school training can do this, and the expense would be insignificant, as compared with the benefits derived. One expert could test the cows of from 25 to 50 dairies, to the number of 300 to 500, once a month for a year, at a cost somewhat as follows : —

Wages of expert, 365 days, at $2,	$730
Team, 50 cents a day, and feed,	183
Babcock tester, glass ware, balances, acid, etc.,	50
	$963

This outlay would make the cost of monthly tests $2 to $3 per cow, perhaps an average of $75 in a 20-cow dairy. I do not believe that there is a 20-cow dairy in the State in which the judicious use of the information so gained would not increase its profits three times the outlay. Farmers, you haven't many opportunities to make $3 in a year by spending $1.

An expert is not limited to the number of herds and animals specified to secure satisfactory results. By expanding so as to make a quarterly instead of a monthly test, a man's capacity could be increased to 1,000 or 1,200 cows, which could thus be tested at $1 a head.

Here is an opportunity for granges to take up a matter of much economic interest to their patrons. If a subordinate grange is too small to warrant the enterprise singly, let two or more combine, or let a Pomona grange undertake it. As a grange, your work would be to find the suitable person for the work; his part would be to secure patronage. This would rapidly increase, when once well started by grange influence.

When dairymen once know the performance of each of their cows, and what it means to them, they will wonder why they have remained in ignorance so long.

SOME PRACTICAL PHASES OF POULTRY FEEDING.

BY JOHN H. ROBINSON, EDITOR OF "FARM POULTRY."

It is an almost universal human habit to regard every result as brought about by a special cause, and in a single way. Most of us grow out of this superficial view in regard to things to which we have to give some thought; but it seems to require a decided effort to keep out of it in dealing with new matters or things which we do mechanically, as we were taught to do them, or have always seen them done. When we engage in something new, or seek to equal the accomplishments of those who have surpassed us in any way, we are apt to look for a key to success, or the secret of success, — for some one thing which is at the same time essential to and a guarantee of success. And when we have found out one thing that seems to be effective for the result we seek to accomplish, we are apt to be satisfied and to look no farther for causes, unless experience (as it often does) soon indicates that there must be other points to consider.

In poultry culture such matters as the merits of breeds, of methods of feeding, of systems of housing, etc., are commonly discussed as if each were of utmost importance. To himself or to others a poultryman propounds such general questions as "Is breed of more importance than feed?" "What method of feeding will give best results in egg production?" "How many square feet floor space must be allowed per hen to keep hens healthy?" "How many hens to a male to insure fertile eggs and vigorous chicks?" and so on through an almost inexhaustible list. Authorities and experts devote much time and space, and sometimes a little temper, to arguments intended to prove favorite breeds, methods or features of prime importance and indispensable; while those who are looking for the truth are at the same time confused by all this disagreement, and more confirmed in the idea that success depends on the discovery of some secret, or the adoption of some special method. Men with commercial or ambitious ends to serve take advantage of the general unsettled state of opinion to exploit, and sell at a premium, their special brands of goods, or to get reputation and credit for their pet ideas. I mention this not to find fault with them. Such things may be done legitimately and honestly; but, in order that we may properly discount statements from such sources, we must know what the conditions are, and allow for personal bias and interest.

In no feature of poultry culture is there so great confusion of ideas at present as in the problems of feeding. Poultry keepers were just beginning to get well out of the mists which had been spread over the whole subject by the advocates of scientifically balanced rations, when their ideas were unsettled anew by the exploitation of "dry feeding," and the projection of a new set of ideas into every discussion of the question of feeding. I sometimes think that perhaps the unsettled state of general knowledge and practice in the matter of feeding is as much to blame as anything else for the poor results in laying and hatching which have been so general in the last four years; but that is a point difficult to prove, and getting its strongest confirmation by analogy from the fact that when the individual poultryman is in such uncertainty on any point, his average results in matters on which it has any considerable influence are likely to be unsatisfactory.

A poultry keeper who is interested in getting better results from his poultry, who is interested in what others are doing, who is always looking for improvement, could not fail to be interested in all these various ideas about, and theories of, feeding, even if he could avoid learning of them, which is practically impossible for such a man. And, learning of these ideas and theories, few can escape being influenced by them. They may not appeal strongly to one with whom poultry affairs are progressing satisfactorily; but as soon as there is occasion for dissatisfaction, as soon as things begin to go wrong, and he can assign no satisfactory reason for it, the poultryman finds himself beginning to ask what there is in this or the other idea or theory for which some claim so much.

In every case, even in those in which there are absurd developments of the foundation ideas or facts, there is a basis of truth and reasonableness upon which to build. The difficulty is not with ideas that are all wrong and theories that are all false, but with those that offer good ideas and substantial facts so mixed with error or so distorted in development and presentation that in the forms in which they are finally set before the public they are of doubtful value, or perhaps positively detrimental.

Thus, in regard to the theory of balanced rations: it is an unquestionable fact that fowls need a variety of food; that they cannot, except for comparatively short periods, be kept productive and thrifty on a diet lacking in variety; but there is a great gulf between that fact and the extreme developments of the "balanced ration" fad. Thus, also, it is an unquestionable fact that mashes, as many poultry keepers make and feed them, are injurious to fowls; but there are differences in mashes, differences in fowls and differences in people. Thus, again, it is certain that many people have injured their fowls by feeding too much corn, or feeding it too carelessly; but again it is true that many others feed corn to advantage. The fault in most exploitations of foods and methods is in claiming too much for them; and in most condemnations of foods and methods, condemning their use when it is the abuse of them that should be avoided.

The more the question of the feeding of poultry is studied, and the more carefully one investigates the results of different methods and follows equal results back along very dissimilar lines of feeding, the more will he be impressed with two facts: —

First, that equally good results are obtained by many different methods.

Second, that the same method does not invariably give the same results.

The logical conclusions from these facts are, that there are many equally good methods of feeding, and that there are other factors to be considered besides quantity, quality and composition of the food.

These conclusions need cause no confusion of mind, and probably would not, if it were not for that prevalent habit to which allusion has been made, — of seeking always to establish a peculiar relation between every result and some less single agency or cause. That habit makes people avoid the logical conclusions altogether, seek to find some other solution of their difficulty; and in the mental confusion which follows they imagine that the matter of feeding poultry is complicated and difficult, when the truth is that it is simple and easy if the poultry keeper will only let it be so, and if he will also maintain as near an approach to natural conditions as is necessary for the proper exercise of natural functions.

It is a matter of common observation among poultrymen that chicks hatched and reared by the natural method will usually thrive on almost any kind of feeding; while those hatched and reared artificially will often fail to thrive on the same ration that naturally hatched and reared chicks on the same premises are given with wholly satisfactory results. Why is it? It is because in the case of the artificially hatched and reared chick the diet so often has to be adapted to some unnatural and abnormal condition. This is usually a condition resulting from improper temperature or lack of ventilation, either in the incubator or in the brooder.

To illustrate: we know that it is possible for an incubator to make a good hatch, and yet the chickens — through some undiscovered wrong condition during incubation — be incapable of living. The most marked instance of this kind of which I know was called to my attention some years ago by an exceptionally expert, careful and intelligent poultryman. From two large machines set at the same time he had taken remarkably good hatches, — about three hundred from each machine. The eggs were the same, one lot of eggs having been divided between the two machines. The conditions after the chicks were put in the brooder house were the same. They were all fed alike. When I saw them, between two and three months after the hatch, hardly a chick had been lost from one lot, while of the other hardly a chick remained. That the difference was due to something which happened during incubation was plain, but what that was it was impossible to say.

It has also often happened that when a lot of chicks from the same incubator are placed in different brooders those in one brooder will thrive, while those in another will not, — all conditions but brooding conditions being the same. The facts plainly indicate something wrong in one brooder. What is wrong it may not be easy to discover.

The bearing of such facts on the question of feeding is this: without being so bad as to cause heavy losses of chicks, brooder or incubator conditions may be such that the chicks are not in perfect condition. Thus, as a result of wrong temperature in either machine there may be a slight catarrhal condition of the digestive organs. To chicks in this condition foods which cause no discomfort at all to perfectly healthy chicks may be at first slightly, and at last highly, irritating, causing serious, if not fatal, digestive disorders. There may be the same difference between chicks hatched and reared by natural methods; but opportunities for errors in hatching and brooding are much less frequent, for hens cannot vary in temperature as incubators and brooders may, and do, — especially in the hands of inexperienced operators.

Now, when we find that an article of food or a system of feeding which, under natural conditions, gives generally satisfactory results, sometimes — either under natural or artificial conditions — does not give satisfactory results, we should know that the fault is not in the food, but in something else; and that, while we may avoid ill consequences by a diet which will counteract the trouble, we do not remedy it. If we think the fault was in the feeding, we may be entirely wrong; and, if so, as long as we continue on the supposition that the feeding was wrong, we are not likely to get at the real trouble.

When a poultry keeper finds that he cannot use a ration which in the experience of others has been shown to be a good ration, he may be sure that there is something else wrong in his flock or his methods. Fowls that are healthy and rugged can use any ration that furnishes approximately what they require, and may do well on such a ration for a long time, though it may be in some respects objectionable, and neither the best nor the most economical ration. But as soon as a poultryman finds that it is only by keeping strictly to a certain ration or system that he can command success, and that variations from it are almost immediately followed by bad results either in health, growth or egg production, he ought not to conclude that his system was so absolutely perfect or his ration so exactly balanced that any variation from it was at once seen to be wrong. He ought rather to conclude that, if his fowls were so dependent upon an exact ration or system, they were so either because so constitutionally weak that, like dyspeptics, they required a diet adapted to their weaknesses, or that there were wrong conditions which something in his ration or system constantly operated to counteract.

So the rational way to look at the matter is that, if fowls or chicks can eat and thrive on practically anything offered them in the line of staple poultry foods, without regard to careful balancing of ingredients of which they are composed, the stock is healthy and sound, and the general conditions conducive to health; but if good results are secured only by careful dieting and rigid adherence to a "balanced ration," there is weakness or error somewhere that is as likely to cause trouble when disturbed or aggravated by other means as when affected by changes in diet. Healthy poultry, like healthy people, are not "fussy" about their eating, but eat with relish all ordinary articles of food, and are not over-particular about the relative proportions of different kinds of food; for the normal digestive system easily takes care of any ordinary surplus without discomfort to the fowl, and often with decided benefit to it.

If the normal, healthy fowl or chick thrives as well on one ordinary good ration as on another (and that it does so is readily demonstrated to any one who compares results fairly), claims of general superiority for any special article of food or mixture of foods are clearly mistaken. The practical significance of this fact is that, understanding it, the poultry keeper can use special foods or systems of feeding to correct some wrong conditions, and can also use whatever available food or system of feeding is most economical or most convenient.

While, as I have said, dependence upon a certain food or system indicates something wrong outside of the feeding, if we have conditions that make us dependent on some food or system, we must continue to use it until by locating the trouble and correcting it we can become independent, and use any foods and methods we choose. I had at one time some stock that had a constitutional tendency to chronic looseness of the bowels. To check and eradicate this I did two things: I began by feeding both the breeding stock and the chicks on dry feed, and by selecting for breeding purposes each year the fowls which showed the least inclination to bowel trouble. In a very few years I had the stock entirely free from the trouble, even when fed the same ration on which the original stock had been always loose.

But it is in such matters as economy and convenience in feeding that the knowledge of the general equality of results of foods and feeding methods for healthy stock is of greatest benefit to those who have it, and should be of most benefit to farmers and gardeners who have at different seasons of the year so many different things which may be used for poultry food, and who often find the method of feeding which suits them at one season of the year inconvenient at another.

On most farms there are available during the fall, winter and sometimes well into the spring waste vegetables of various kinds, which, with a little special preparation, are made more palatable to the fowls than if fed in their raw state. Small potatoes, beets, turnips and other vegetables, cooked and made the basis of a mash of meal and shorts, can be used to good advantage and with less waste in that way than in any other. It takes a little time to prepare them. Whether it is best to use that time in that way must depend on how profitably it would otherwise be employed, and the value of the food thus utilized.

From the time farm or farm garden products begin to be marketed, there is on most farms considerable waste which may be fed to poultry or other stock. Sometimes the articles and the amounts of them available for poultry are such that it is not only unnecessary but would be detrimental to the fowls to feed them freely, and also to feed a wet mash. At this season of the year, too, there is on most farms other work more pressing and more profitable than keeping up through the summer the system of feeding followed during the winter. So, with an abundance of green food either supplied to the poultry in their yards or ranges or fed from the field or garden, there is no need of feeding ground grains, either wet or dry, and the work of feeding the poultry may be reduced to occupy but a very short time. Possibly the gross results may not be as good when the attention to feeding is reduced to the minimum. I think the general experience of poultry keepers shows that the best gross results are obtained when fowls get a great deal of attention, — not fussy or annoying attention, but judicious attention. It is so with all animals. By giving them a considerable variety of food, prepared in a variety of ways, we tempt the appetite to take the largest possible quantities of food, we avoid in no small degree the dangers of overeating of a single article, and we get in poultry better growth and greater egg production; but whether we get enough better results to pay for the extra trouble and food required is something to determine each time the question arises, in accordance with circumstances at that particular time and place.

Some poultry keepers on farms, or elsewhere, are so situated that it is desirable to reduce the work of feeding the fowls as much as possible at all seasons of the year. To such the dry feeding methods so much advocated of late years often present the most satisfactory solution of the feeding problem. It has become customary to describe any system of feeding which omits the wet mash as "dry feeding." The advocates of dry feeding generally have made sweeping condemnation of wet mashes, and have charged against their use all the ills discoverable in any flock to which a wet mash happens to have been fed. As would be expected, they have also gone to the extreme in claiming all sorts of beneficial results from dry feeding. I think that any fair general consideration of the facts will show the same diversities in results that are found when we attempt to make out a case for any method by attributing to it alone results in cases in which it is a factor. It is impossible to prove the superiority of a method or a breed by a comparison of individual instances. The surest test is the test of time and general use. That test operates slowly, and leaves us always with a measure of uncertainty as to the final result; but in compensation it also gives us — if we heed it — caution in accepting results of new methods prematurely.

The situation with regard to the dry feeding of poultry to-day is that, without approaching a full demonstration of their claims for that method, the advocates of dry feeding have materially benefited many who were not successful in the use of the mash system, and have emphasized a principle, which may well be termed a fundamental principle in feeding, that had fallen into general disuse among those trying to feed poultry for best results, — that is, the very elementary principle that to lay well or grow well, fowls must be well fed.

A prominent feature of the teaching of the "balanced ration" advocates was the necessity of avoiding over-feeding. So insistently were the evils of over-feeding proclaimed, and so much were poultrymen impressed by this preaching, that among those trying to feed right over-feeding had become extremely rare, while it was a common thing to find poultrymen feeding rations just short enough of what they should be to give good egg yields. So general have I found this, that, beginning some years ago, in every case where a correspondent wrote asking what was the matter with his hens, that would not lay, in which I could find no special cause for failure, I have advised to feed a little more, and it is quite surprising how often this happens to give the results wanted.

Now, the dry feeding system, as usually advocated and practised, keeps food before the fowls all the time. They need never be hungry. And in nearly all cases where dry feeding has given better results than a system including a wet mash, and the wet mash used was of good consistency, I think it will be found that the dry feeding system owes its apparent superiority to the simple fact that by it the hens get enough to eat.

And that, as a matter of fact, is the prime factor in successful feeding. There are other points to consider. Hens must have exercise, and there must be some variety in their food, but above all, if we wish good development and good egg production, there must be abundance of food. And, from what I have seen of results of many different methods of feeding, I would say give abundance with variety; but, if there is a choice between variety without abundance and abundance without variety, the latter is to be preferred. In abundance of food without variety we may get results and wear the fowl out quickly; in the other way we are more likely to keep a fowl just short of profitable performance.

Some of the best results in winter egg production I have ever seen have been obtained from flocks which were not handled in the best way. There were faults in the management during the winter which might have been avoided; but the poultrymen made their fowls pay better, in spite of these faults, than most others did without them, and they did this simply by working on the principle of giving their fowls all they could eat. I went one day to visit a poultry farmer who had the reputation of always getting good egg yields in winter. What I saw in the nests in his houses in the dead of winter seemed to justify his reputation. I asked him to what he attributed his success. He replied, "The only difference I can see between my poultry keeping and that of those poultrymen about here who complain that they can't get eggs is that I keep food before my hens all the time." His hens were inclined to get too fat toward the end of winter, and fall off in egg production; but he made more than he lost by heavy feeding.

A Maine farmer whose farm I visited several years ago had about five hundred hens, and kept cracked corn before them all the time. They had the range of the farm in summer, but were not out of the houses much in winter. He was said to be the only farmer in that neighborhood who always had eggs to ship to Boston in December and January.

I once asked one of the most successful poultry keepers of my acquaintance, a man who combines poultry keeping and general farming, what he thought was the principal thing in winter egg production. He replied that it had been his observation that if pullets were ready to begin laying about the beginning of winter they would begin and lay right through, provided they got enough to eat; and that he could not see that it made much difference — within the range of usual poultry foods — how or what they were fed; the all-important thing was to give them all they could eat. Of course he did not mean that the kind and quality of food made no difference. In making such a statement, it is understood that the reference is to rations such as good poultrymen would use.

Good feeding sometimes consists more in using to advantage waste products and cheap products than in getting large results. To do this the poultry keeper must be in a measure independent of systems, — not bound either by wrong conditions, or weak stock, or faults in his methods, to follow carefully a delicately balanced system.

CLOVERS: THEIR VALUE, CHARACTERISTICS OF VARIETIES AND METHODS OF PRODUCTION.

BY PROF. WM. P. BROOKS, PROFESSOR OF AGRICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

Most farmers who keep stock appreciate the fact that the clovers are among the most valuable of all the forage crops that can be produced in Massachusetts. The reasons why the clovers are so important are not always clearly understood. In this article the writer will attempt to make these reasons clear. Not infrequently, in personal interviews or by letter, the writer's attention is called to the fact that in some localities farmers are meeting with poor success in their efforts to produce this valuable class of forage crops. The reasons for comparative failure in efforts to produce clover doubtless vary in different localities, and it may not be possible for one unfamiliar with conditions to give directions which will always lead to success. Certain conditions, however, which are well established, must be provided, or failure will be the result. An effort will be made to make a clear statement as to what these conditions are, for it is in many cases at least true that comparative failure in the effort to produce clovers is due to a failure to observe some one or more of these conditions.

Reasons why Clovers are especially Valuable on the Farm.

It is the writer's opinion that on farms where stock is kept it will usually not be profitable to use clovers as green manures. They can be better utilized on such farms by cutting and feeding to stock, or by pasturing. On the other hand, where but little stock is kept, and especially where the production of apples, peaches or other tree fruits is an important part of the farm business, the clovers are among the most valuable crops which can be used for cover, to supply humus, and to enrich the soils in nitrogen. It is now generally understood that under right conditions clovers are capable of taking the nitrogen which they need from the air. In this respect the clovers and the other plants of the clover family are superior to any other crops which can be used for similar purposes. It is, then, this single fact, that the clovers can take the nitrogen they need from the air, while crops of other families cannot do this, which renders them so much more valuable than most other crops for cover and green manuring. It is the purpose of this article to consider especially clovers as forage crops. A brief statement of the principal reasons for their great value as such may be useful.

1. The cost of manures and fertilizers needed to produce them is low. As has just been stated, the clovers under the right conditions take their nitrogen from the air. They draw upon the soil simply for the mineral constituents of plant food, such as lime, phosphoric acid, potash and magnesia. These mineral elements of plant food are relatively abundant, and can be purchased at comparatively low prices. Nitrogen, on the other hand, if purchased in the form of either manure or fertilizers, will usually cost from 16 to 18 cents per pound. Phosphoric acid and potash cost only 3 to 5 cents per pound, the price varying according to the material selected. Lime and magnesia cost still less. The latter, indeed, need seldom be purchased, for it, as well as the other mineral constituents found in plants, is almost invariably sufficiently abundant in all soils. Striking evidence that the manurial cost of producing clovers is low is afforded by the results in one of the fields of the Hatch Experiment Station. A plot in this field was manured annually for fifteen years at the following rates per acre: dissolved bone black, 320 pounds; and muriate of potash, 160 pounds. The crops raised on this field, in the order of their production, were as follows: corn, corn, oats, hay, hay, corn, rye, soy beans, white mustard, corn, corn, hay, hay, and corn. The hay crops have consisted in all cases of mixed grass and clovers. During the fifteen years referred to, the entire field has received two applications of lime, at the rate in each case of 1 ton to the acre. The annual cost of the dissolved bone black and muriate of potash applied to this plot has been at the rate of about $5.50 per acre, while the cost of the two applications of lime has been sufficient, spread over the fifteen years, to amount to about $1 per acre annually. The total cost of manuring this land, then, has been at the rate of about $6.50 per acre annually. This plot has invariably produced good crops. Its fertility does not appear to have decreased. In 1902 it produced shelled corn at the rate of 56 bushels to the acre. Clover has always predominated in the hay crops. The yield of hay (two crops) in 1901 was at the rate of 3,400 pounds to the acre. That portion of this field which has not been manured during the fifteen years will at present yield corn at the rate of about 7 bushels of shelled corn per acre, and hay at the rate of about 600 pounds.

Some of the fields of the Massachusetts Agricultural College farm are kept permanently in mowing. A number of acres have not been broken up for about twenty-four years. In 1889, when the writer took charge of these fields, they were producing rather light crops of Kentucky blue grass, much mixed with the white daisy. For the last few years these fields have been subdivided into plots, and various combinations of fertilizers employed. To a considerable area, the annual application per acre is at the rate of basic slag meal 500 pounds, and a potash salt sufficient to furnish 75 pounds of actual potash per acre. The areas thus manured have steadily improved under the treatment received. At the start there was but little clover. Under the system of fertilizing followed, the proportion of clover has steadily increased. The daisies have almost entirely disappeared, while the grass as well as the clovers, though in less degree, has improved. The annual cost of the fertilizers used amounts to about $7 per acre. The soil of these fields is natural grass land, and is quite well adapted for clovers as well. The product under this system of manuring ranges from about 2 to 2½ tons per acre in two crops. During the present season these fields have given one of the best as well as one of the heaviest crops produced since 1889.

2. Clovers are of especial value upon the farm as stock feed, on account of their exceptional richness in protein. Protein, as is well understood, is the most valuable of the food constituents, being essential to the formation of flesh, and undoubtedly influencing milk production to a greater degree than any other food constituent. Hay made from grasses is likely to contain only 6 to 8 per cent of protein; hay made from clovers, on the other hand, is likely to contain from 12 to 14 per cent. Every farmer, however, who has had experience knows the superior results which can be obtained in feeding when good clover hay is available. This point, therefore, needs no further discussion.

3. The production of clovers under the right conditions enriches the soil. This is true even when the crops produced are cut and removed. Clover, as has been pointed out, is capable of taking its nitrogen from the air. Not only does it take from the air under the right conditions a large proportion of the nitrogen which becomes a part of its stems, leaves and flowers, but it takes also large amounts of nitrogen which become a part of its root. The 3 tons of clover hay which an acre of good clover land will produce in a year will contain about 120 pounds of nitrogen; and yet after the production of this crop the soil will contain more nitrogen than it did at the start, if conditions have been right, for the roots and the stubble of the clover are very rich in this element, and when these decay, the nitrogen they contain becomes a part of the capital of the soil, and this nitrogen has been taken from the air and thus brought within the reach of subsequent crops through the agency of the growing clover.

In one other direction the growth of clovers is likely to result in soil improvement. Most of them are very deep-rooted plants. They have long, thick tap roots, which run down into the soil. As a consequence, the sub-soil is opened up and mellowed. The availability of the stores of plant food in it, as well as in the surface soil, is increased. Crops which follow clovers are likely to send their roots deeper into the soil than when following grasses, which are more shallow rooted. Under these conditions crops are less likely to suffer from drought. They gather food from a wider soil area, and are consequently more certain and less dependent upon applied fertility. The fact that other crops almost invariably do well when following a good crop of clover is generally understood among farmers of experience, and these points, therefore, do not appear to need further discussion.

4. The fact that when a clover sod is broken up the following crops do exceptionally well has just been pointed out and is generally understood. That the grasses growing in the field with clovers in permanent mowings will ultimately derive great benefit from the clovers which have grown with them is not so generally understood. That such is the case, however, cannot be doubted. European experience has demonstrated it, and many observations in America confirm the results of European experience. It will be of interest to consider how this effect is produced. As has been pointed out, a suitable selection of fertilizers will maintain a large proportion of clovers in permanent mowings. It must be remembered, however, that the individual clover plants are not long lived. Most of our clovers are short-lived perennials. The single plant will not, as a rule, live more than two or three years. Clover is permanent in the mowing simply because some of the seed almost invariably ripens previous to the cutting of the crop. Considerable numbers of individual plants undoubtedly die every year. It is the decay of the roots and stubble of these plants which accounts for the benefit to the grasses. Grasses thrive where nitrogen in available forms is abundant in the soil. The decay of the roots and stubble of clovers brings this element within the reach of the grasses, and thus the clovers, which first help themselves by drawing nitrogen from the air, in their death and decay help the grasses as well. Any permanent mowing which at the outset is brought into good condition to produce clovers in a few years will also be in a condition to produce a strong growth of grasses as well as clovers.

For four important reasons, then, the clovers are among the most valuable of forage plants: first, the manurial cost of their production is exceptionally low; second, they are richer in protein than most of the forage crops, — far richer than the grasses; third, they enrich the soil in nitrogen, as well as sub-soil it, so that the following crops are almost invariably good; fourth, in permanent mowings they ultimately so enrich the soil in nitrogen that the grasses as well as the clovers make vigorous growth.

THE KINDS OF CLOVER.

Crimson Clover (Trifolium Incarnatum).

Crimson clover is an annual or a winter annual.[1] Whenever crimson clover can be grown as a winter annual it is of much value, but the peculiarities of our winters and especially of our springs are such that crimson clover is not generally successful as a winter annual. In localities where it is hardy, its special value is due principally to the fact that it starts into growth the following season much earlier than the other clovers. Crimson clover may be grown in Massachusetts as a spring-sown crop, but if it must be sown in the spring it will not be earlier than the other clovers, and is not likely to yield so heavily as they. It does not appear likely, therefore, that crimson clover will prove of much value in our agriculture.

Medium or Common Red Clover, and Mammoth Red Clover.

These two kinds of clover are best described together, as the peculiarities of each are best brought out when studied in contrast with those of the other. These two kinds of clover resemble each other very closely. Typical specimens of the two show well-defined differences, but these two types of clover seem to run together, and there are many forms intermediate between the types. The product of commercial samples of seed sold under the two names is often indistinguishable, even by experts. Typical specimens show the following differences: the leaflet of the red clover is nearly round, comparatively smooth, with a whitish approximately crescent-shaped mark on the upper surface; the mammoth clover has a leaflet relatively narrow, elliptical, more hairy than that of the common red clover and without the whitish mark. The more important practical differences are that the mammoth clover is somewhat coarser and taller than the common, and a little later. It is, therefore, somewhat better suited for sowing in mixture with timothy and redtop than the common red clover, for the latter is usually overripe before the timothy and redtop are sufficiently mature to cut. Both of these clovers are rather short-lived perennials; but it is nevertheless possible, as has been indicated, to produce hay for a long series of years in permanent mowings in which these clovers will be fairly prominent. This is possible even without sowing the seed, for when the rowen crop is usually harvested a portion of the heads are commonly ripe. The seeds are scattered from these heads, and from these seeds each year come new plants. Accordingly, though the older plants die, their place in the mowing is taken by the plants which grow from these accidentally scattered seeds.

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[1] Those plants are designated winter annuals which, when sown in late summer or fall, make a moderate growth, but do not blossom that season; but which will pass through the winter successfully, blossom and form seed the following spring, and then die. Winter rye is an example.

Alsike Clover.

Alsike clover was once supposed to be a hybrid between common red clover and white clover. It is now known that this is not the case; it is a distinct species. In characteristics, however, it is intermediate between the common red and the white, showing a wonderful blending of the qualities of the two. It has the upright habit of growth of the red clover, though it is not so coarse. The head is shaped like the head of the white clover, while the color of the flowers is pink. Alsike clover is of much value in mowings, and seems to be especially adapted to the stronger and moister soils, where it does better than the common red. Being finer, it cures more easily than either the common red or the mammoth clover, producing hay of very superior quality. It is, moreover, of great value as a honey crop, for the honey bee can reach the nectar in its flowers, which it can seldom do in the case of the red and mammoth clovers. In a few respects alsike clover appears to be somewhat inferior to the red and mammoth varieties. In many cases it does not persist so long, nor does it appear to yield so heavy a second growth. The variety, however, is of such value that it should always be included in mixtures of seeds for the stronger and moister soils, where hay including clover is desired.

White Clover.

This plant is too well known to need description. Unlike the other clovers, it is perennial. Its ability to persist is due to the fact that its stems creep upon the ground, rooting at the joints wherever they come in contact with the soil. This clover is, therefore, constantly renewed, as a result of this habit of growth. This same habit renders this clover less valuable in mowings than the others which have been spoken of. In all permanent mowings, however, white clover will contribute greatly to the yield and to the nutritive value of the product. In such mowings it appears invariably to come in naturally if the soils are adapted to it, and if the necessary mineral elements of plant food are abundantly supplied. White clover is of great value in pastures. A turf in which white clover is abundant is most highly relished by all classes of stock, and the feed is highly nutritious. The white clover, moreover, is much the most valuable of all the clovers for bees. It secretes nectar abundantly, and the honey made from it stands highest in our markets, being, indeed, almost everywhere looked upon as the standard of excellence among the different grades of honey.

Varieties of the Different Species.

Critical examination of either grasses or clovers in the field will reveal the fact that the different plants exhibit considerable variation. In the United States, while we have countless varieties of vegetables, grains and fruits, we have thus far made little effort to produce select and more perfect varieties of our different species of forage crops. We have been satisfied to go on year after year sowing a mixed or average seed. The tendency to vary among the different species of clovers is apparently not less than it is in many other species of cultivated plants. It cannot be doubted that by intelligent effort greatly improved types, or types suited to widely different purposes, may be produced. Foreign countries are ahead of us in this direction; and on the experiment station farm at Amherst there is now a considerable collection of varieties of clovers, — of the red, alsike and white species respectively. The different varieties exhibit wide differences one from the other, and some of them have great apparent promise. These varieties of clovers have not been under trial sufficiently long to justify sending out any of them, but it is among the possibilities of the near future that we shall have highly improved types of the different leading species of clovers, — types which are suited to varying conditions or to different purposes. Meanwhile, in conclusion upon this topic, the intelligent clover grower is urged to keep his eyes open for promising plants, and, finding them, either to propagate from them himself, or to send them to the experiment station, where they will be given careful trial.

THE CONDITIONS ESSENTIAL FOR THE MOST SUCCESSFUL AND PROFITABLE GROWTH OF THE CLOVERS.

1. *Soil Conditions.* — Successful clover growing is impossible unless the soil conditions are right. These plants will thrive upon a considerable variety of soils as regards texture and composition, but for the best results a deep, mellow and fairly retentive soil which is well drained is essential. Clovers will absolutely fail if there is any considerable proportion of free acid in the soil, or, in farmers' language, if the soil be "sour." If blue litmus paper in contact with moderately moist soil turns red as it absorbs the moisture, this is an indication that the soil is sour; but the farmer will be wise if, before incurring any considerable expense for the correction of acidity, he makes a careful test for himself. One of the best farmer's tests can be carried out as follows: take two small plots of land in a field supposed to possess "sour" soil, and plow them both. Plots containing about one square rod each will be sufficient. They should, of course, be located in a representative portion of the field. After plowing, spread about 20 pounds of builders' lime or R-R agricultural lime on one of the plots. Work this lime in deeply with the wheel harrow, then manure or fertilize both plots alike and heavily, and plant table beets. If the soil is sour, these beets will grow much better on the plot to which the lime has been applied than on the other, and it is safe to conclude that a heavy application of lime will be essential before clovers will flourish. If the experiment indicates that lime is essential, it will probably be

needed at about the rate of 1 ton to the acre; the weight referred to to be taken before slacking. If air-slacked lime is used, 1½ tons to the acre will not be too much. The best season for applying lime is autumn or early spring. As a rule, it should be spread upon the plowed land and deeply worked in with the disc harrow.

2. *The Use of Much Manure inexpedient.* — The writer is aware that splendid clover is often grown where the land is heavily dressed with manure. He is not disposed to deny the possibility of producing fine crops of clover on manure alone. He would, nevertheless, urge that manure alone be not depended upon as a means of enriching clover land. The leading and most valuable element of plant food in manures is nitrogen. The application of this for clovers in any considerable amounts is unnecessary. If clovers are grown on manures, they will feed upon the nitrogen in the manure; they will not draw from the air for that element. Growing clover upon manures, therefore, is not the best economy. Moreover, it is important to point out that the grasses with which clover is most generally grown are greatly invigorated by heavy dressings of manure. A strong, rank growth of the timothy and redtop will tend to crowd out the clover. Fine crops of hay may be produced, but it will not be clover hay, nor rich in clover. The writer would not be understood as urging that manure should never be used on land which is being prepared for clover, although he would strongly advise against top-dressing clover with manure. On soil which is naturally poor in nitrogen, manure may wisely be used in moderate amounts for crops preceding clover. Heavy dressings would be a mistake. It is far better to use the manure in only moderate or small amounts, and to use it in connection with materials which will supply lime, phosphates and potash.

3. *The Supply of the Mineral Elements of Plant Food should be Liberal.* — We should not forget, in considering the best means of growing clover, that the stock of nitrogen in the air from which it is capable of drawing is practically unlimited. The more of this nitrogen we can gather in the crop and in its roots and stubble, the better. In a certain sense, this trapped atmospheric nitrogen is so much clear gain. In considering this point, it must be remembered that the clover plant, like other plants, must take the different food elements in a certain balanced proportion. Though the nitrogen the clovers need is practically unlimited in amount, they cannot make a heavy growth unless provided with a great abundance of the elements which they must take from the soil. It is clearly unwise to lessen our chances for gathering the valuable element nitrogen from the air through failure to supply the soil elements in adequate amounts. The rule, then, in preparing for clover or in top-dressing for clover should be to supply the phosphates, potash salts, lime and possibly magnesia in great abundance. With these present in abundance, and with a soil of such a character that it will furnish suitable conditions and supply the

needed moisture at critical times, enormous crops of clover may be produced.

4. *The Co-operation of Bacteria is essential.* — One of the most important discoveries of recent times is the now generally known fact that the presence of certain bacteria living in symbiotic relations with the clovers and other members of the clover family, and found in nodules on their roots, is essential in order that these plants may draw upon the air for nitrogen. The nodules which in the case of clovers indicate the presence of suitable bacteria are whitish, more or less elliptical bodies, of about the size of the head of a small pin. These grow singly or in small clusters, mainly on the smaller roots. They can be readily found by taking up clover plants grown under proper conditions, with care not to break off too many of the small roots. Bacteria, as is generally understood, are plants. They are very minute. The bacteria themselves are the veriest dust of the dust. As might be supposed, therefore, they appear to be very widely and freely disseminated, and probably through the air. The slightest currents of air must carry them. The dust from a freshly turned clover sod must contain countless millions of them. In certain quarters it has been urged that failures to produce good clover are frequently due to the absence of suitable bacteria, or to their presence in insufficient numbers. Certain experiments with sterilized soils in Amherst indicate to the writer that clover bacteria are everywhere; and it is not his belief that failures to produce satisfactory crops of clover in this State can often, if indeed they can ever, be attributed to the cause under consideration. The writer has never seen a case where, if a soil be brought into proper condition as to drainage and freedom from acidity, and well stocked with phosphates and potash, clovers have failed to grow; and he has never observed clover plants in any locality and failed to find abundance of nodules on their roots. It is, however, of course a possibility that there may be localities where it will pay to inoculate the soil designed for clover with suitable bacteria. This inoculation may be carried out in either of two ways. First, soil from a locality where clover thrives and where the nodules are known to be abundant may be scattered over the field where the clover is to be sown, and immediately harrowed in. Five or six hundred pounds of such soil per acre will be sufficient. Second, a culture of the proper species of bacteria may be used in accordance with directions which will be furnished with it Such cultures may now be procured either from the United States Department of Agriculture in Washington, or from private dealers. These cultures are known by the name of nitro-cultures; but, as each species of the clover family must have its own species of bacteria, it is necessary in ordering to name the plant for which the nitro-culture is needed, as well as the area.

The United States Department of Agriculture first sent out cultures in dry form, in small packages containing dried cotton and chemicals, to be dissolved in the water in which the cultures were to be started. In very many cases the use of these cultures resulted in absolute failure. The desiccation to which the bacteria had been subjected appeared to have destroyed their vitality. So far as the writer knows, all private companies which are now offering commercial nitro-cultures prepare them in accordance with the system first used by the government, and the presumption is that in many cases these cultures will be found valueless, and for the reason above indicated. The United States government at the present time is preparing cultures in semi-fluid form. These are sent out in sealed glass vials. They have not been sufficiently tried to warrant an expression of opinion concerning their value, but the method, at least judged from a scientific point of view, appears better calculated to yield successful results than the earlier method.

It has been urged that the bacteria sent out in culture form are selected and especially vigorous forms, and that accordingly, even in cases where the soils contain the right species of bacteria, the clover crop may be increased, or may be enabled to draw nitrogen in larger quantity from the air through suitable inoculation with these improved cultures. It does not appear to the writer that this point has been as yet proved, and in conclusion he would go on record as most emphatically advising against the use of cultures for clover, unless, indeed, it is found on experiment that clovers do not develop in any given locality the characteristic nodules.

Fertilizers for Clovers.

In considering this topic, we shall do well to consider separately clovers grown in rotation with other crops and clovers in permanent mowing.

For Clovers in Rotation.

Where clovers are grown in rotation with other crops, they will occupy the land at most but two or three years. In such cases practically all manure or fertilizer used will be applied previous to seeding. On most farms where stock is kept, manure in larger or smaller quantity will be used for the crops which precede the clovers. It has been pointed out that it is a mistake to use manure too freely for the crops which precede the clover. Application at the rate of 4 to 5 cords to the acre only is desirable. In connection with such applications of manure, materials which supply phosphates, potash and perhaps also lime should be employed During the past few years large quantities of phosphatic or basic slag meal have been employed on the college farm at Amherst, and with results which are eminently satisfactory. This slag meal should contain about 16 to 20 per cent of actual phosphoric acid. This acid is not in so highly available a form as in acid phosphate or dissolved bone black. On the other hand, it appears to be more available than the phosphoric acid in any of the phosphatic rocks, or even in most of the forms of bone. Besides phosphoric acid, the slag meal contains a large amount of lime, and this, while less effective in correcting the faults of a sour soil than quicklime, must prove valuable in helping to prevent soils which have once been brought into proper condition from becoming sour again. On such soils as those at Amherst the application of slag meal at the rate of some 500 or 600 pounds per acre in connection with such dressings of manure as have been indicated appears to be sufficient. In addition to the slag meal, there will be needed on most soils to bring them into suitable condition for producing clovers a fairly liberal application of potash in some form, for this element the 4 or 5 cords of manure will not supply in sufficiently large quantities for the best results with clover. Wood ashes furnish potash in very desirable form, but they are becoming increasingly scarce, and are held at prices which make them a relatively expensive source of that element. It is the practice on the college farm to depend mainly upon some of the German potash salts; and, as has been pointed out in earlier articles on the hay crop, sulfates of potash are found in the long run to give much better results with clover than muriate of potash or kainite. Experiments now in progress in Amherst are furnishing an interesting basis of comparison between the low-grade sulfate of potash and the high grade. The writer is not yet prepared to recommend the low grade as superior to the high grade; and, since the latter furnishes actual potash at the lower cost, it is his belief that it should usually be selected. Comparative observations, however, on crops grown on the two potash salts this year lead him to wonder whether the magnesia of the low-grade sulfate may not ultimately prove valuable. Certainly better clover is seldom seen than that produced on certain of the fields of the college farm during the past year, which have been during the past few seasons top-dressed with basic slag meal and low-grade sulfate of potash. If the high-grade sulfate of potash, however, is selected for use in connection with manure in preparing for clover, it is believed that an annual application at the rate of about 150 to 175 pounds per acre will supply the element potash in sufficient quantities for clovers on most soils. These materials (basic slag meal and sulfate of potash) should be mixed after the land has been plowed, spread broadcast and harrowed in.

Fertilizers without Manures.

In some cases the farmer will desire to bring his soil into suitable condition for clovers in rotation by application of fertilizers alone to preceding crops. In such cases the materials which have just been considered should constitute the main reliance, but they should be used in connection with materials which will furnish nitrogen in sufficient quantities for the preceding crops. Both the slag and potash, however, must be used in somewhat larger quantities; and the writer would suggest as suitable for most cases basic slag meal 800 pounds and high-grade sulfate of potash 200 pounds, though these amounts may, of course, wisely be varied to some extent according to the crop which precedes the clovers. What materials it will be best to use for the purpose of supplying the needed nitrogen for the preceding crop, and in what quantities, it is impossible to say without knowledge as to what that preceding crop is to be. If corn, only moderate quantities of nitrogen would be required, and this may wisely be furnished in materials furnishing this element in forms varying in availability. As a rule, the needed nitrogen may wisely be obtained by a combination of nitrate of soda, tankage and possibly raw bone meal; and for corn, in the proportion of about one part of nitrate to three of tankage and two or three of bone meal. The total quantities of these materials which it will be profitable to use for corn in connection with slag and potash must vary widely with the condition of the soil. Six hundred pounds of a mixture with the different materials in the proportions indicated will ordinarily be sufficient. All these materials, nitrate, tankage, bone, meal, slag meal and potash, may be mixed after the land is plowed, spread broadcast and harrowed in.

Fertilizers for Clovers in Permanent Mowings.

To get permanent mowings to produce hay composed largely of clovers, it will be wise to depend chiefly upon the fertilizers which have been under consideration. Basic slag meal or bone meal should be mainly depended upon as sources of phosphoric acid, and lime and either the high-grade sulfate or low-grade sulfate of potash as the source of potash. Excellent crops can be produced by a combination in suitable amounts of these materials alone, and the clover will comprise a larger proportion of the product if they be used without materials which will supply nitrogen. On the college farm at Amherst crops of hay rich in clover have been produced year after year by an annual top-dressing composed of a mixture of basic slag meal 500 pounds, and either high-grade sulfate of potash 150 pounds or low-grade sulfate of potash 300 pounds per acre. The product under this annual system of top-dressing shows fairly good grass, with a bottom full of white clover which grows with remarkable luxuriance and attains unusual size. The fields thus top-dressed contain also many plants of the red clovers. These in the crop of the past year seem to be more abundant where the high-grade sulfate of potash was used than where the low grade had been applied. Basic slag meal is not yet common in our markets. If it be found difficult or impossible to obtain it, bone meal may be substituted for it; but it is not likely that it will permanently hold the land in a condition so favorable for clover as the slag meal, for it does not contain lime in so large proportion. The bone meal, however, furnishes a small amount of nitrogen, and this fact may render it somewhat more favorable for grass than is the slag meal.

It seems probable that in most cases somewhat more profitable crops of hay will be obtained if in connection with either the slag and bone meal or the potash salts a moderate amount of nitrate of soda is employed; and experiments in Amherst indicate that from 150 to 200 pounds per acre of this salt in connection with the other materials seem to be as large an amount as in seasons with abundant rainfall may profitably be used on strong and retentive soils. On the lighter soils the nitrate may without doubt be more largely employed with profit.

In top-dressing permanent mowings, whether with the slag meal or bone and potash alone or with these materials in connection with nitrate, it is the practice at Amherst to mix the materials and to apply the mixture about the first of May. There can be little doubt that the slag and the potash salt will do the crop of the succeeding season more good if applied in the autumn; but applying them at this time would mean going over the ground twice, — once with the mixture of slag and potash and once with the nitrate. It would, moreover, be found difficult to apply the small quantity of nitrate evenly by itself; and it seems doubtful, therefore, whether in the long run better results will not be secured by applying the mixture of all the materials in the spring.

SEEDING TO CLOVER.

As has been pointed out, it is almost invariably best in general farming to sow the clovers in mixture with grasses. Clovers growing alone are not likely to stand up well. If sown in mixture with a stout growing grass, such as timothy or orchard grass, the clovers retain their upright position much better than when growing alone. If, however, for any purpose it is considered desirable to sow clovers alone, the following quantities of seed per acre will usually be sufficient:[1] —

Red clover,	15 pounds.
Mammoth clover,	20 pounds.
Alsike clover,	12 pounds.
White clover,	8 pounds.

Spring Seeding.

The clovers are sown in spring in either one of two systems. First, it is common practice to scatter clover seed in very early spring on the surface of fields which have been seeded the previous fall either with grain or grasses. Under these conditions the soil cannot be freshly prepared, nor can the seed be covered. As might be expected, therefore, germination is less perfect than under more favorable conditions. When, however, the weather conditions are just right, a fair degree of success is attained by seeding in this way. It is usually best to defer sowing until the winter's frost is out of the ground. Results are most satisfactory when the seed can be sown on a lightly frozen surface which is somewhat honeycombed with the night's frost. If as this frost comes out of the ground, or soon after it comes out, there should chance to come a rain, the seed is much of it carried into the soil, and will usually germinate promptly and quite perfectly. Owing to the fact, however, that we are by no means certain to experience these ideal conditions, there is considerable risk in seeding with clover in accordance with this plan. It should be recognized, moreover, that, even if the seed germinates well, the clover sown in this way on land seeded to grass the previous fall makes but little showing in the crop of the succeeding season.

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[1] For seed mixtures for various purposes see article on "Hay Crop in Massachusetts," by the writer, in the fifty-second annual report of the secretary of the State Board of Agriculture.

Second, the land may be plowed as early in spring as it can be worked, and the clover sown either alone or in connection with grass seeds, with or without grain as a nurse crop. Clovers sown in this way usually start well, but, whether they be sown with grain as a nurse crop or not, they are subject to peculiar risk and injury during the summer. If sown with grain as a nurse crop, this must be harvested usually during July. If sown alone, there will usually be a considerable growth of weeds, and these also, in order to prevent ripening of seed, must be cut at about the same time. The clover which has previously been shaded either by grain or weeds is in poor condition to stand full exposure to the hot sun of midsummer, and unless rains come within a short time after it is thus exposed, much of it is often killed. This method of seeding, then, leaves much to be desired.

Seeding in Summer or Early Autumn.

The best success in seeding to clovers can usually be counted upon when the work is done in late summer or very early autumn. Dog days furnish ideal conditions for germination and rapid growth. Clovers may be sown at this time either alone or with grasses. If the field can be cleared, plowed and thoroughly harrowed, it can be brought into the very best possible condition; but where clover is to follow corn, it is impossible to remove the corn in season to sow the clover. Under these circumstances, seeding in corn appears to be the best plan. The ensilage corn, since it is carried from the field as soon as cut, furnishes conditions on the whole more satisfactory than field corn, with which the young grass and clover will be killed where the stooks of corn stand while curing. In the seventeen years that the writer has had charge of the college farm in Amherst, a good many acres have been annually seeded in corn, and during this entire period there has never been a failure. The culture of the corn should be level. A spike-toothed cultivator should be used at the last cultivation, and the seed should be immediately sown. It will not need covering. The best time for sowing in this way is usually between July 20 and August 5. It is desirable to sow the seed before the corn is so tall as to make it difficult to swing the hand over it in sowing. Those who have not tried this method of seeding appear usually to fear that the stubble of the corn will be in the way in harvesting the hay crop; but if the field be rolled the spring following the seeding, no such difficulty will be experienced. Clover sown in this way in the corn becomes thoroughly established before winter, it is very unlikely to winter-kill, and it will give a full crop the following season.

Selection of the Seed.

The clover seeds upon our American markets appear usually to be of very good quality. European seed dealers have sometimes mixed specially prepared sand of approximately similar color and sizes with clover seeds; but, so far as the writer knows, this fraud has never been undertaken in this country. In purchasing clover seed, then, it seems necessary only to use care to obtain that which is free from admixture with weed seeds, and which shows good germination. Among the weed seeds most likely to be found mixed with clover seeds are dock and sorrel. These can easily be recognized. There is occasionally a sample of clover seed containing the seeds of dodder, — a thread-like parasite, which attaches itself to the stems of the clover plants. Where this is abundant the crop is practically ruined. The stems of the dodder straggling from stem to stem unite the different plants so that they cannot be separated; it therefore becomes almost impossible to handle and cure the hay. The presence of dodder, moreover, renders the hay very unpalatable. The seed of the dodder is excessively fine, and in cases where its presence is suspected a sample of the seed should be sent to the experiment station for identification.

Curing the Hay.

The first point to be considered in connection with this topic is the proper degree of maturity. Clover is often allowed to stand too late. If it be suffered to remain until a considerable proportion of the heads are brown and the seed ripe, there will be but little rowen, while there is much danger that the roots of the clover will die after the crop is cut. Relatively early cutting, then, — before many of the heads are brown, — is desirable, both because a better rowen crop will be secured and because the clover will persist in the mowing longer.

Good weather is essential for the satisfactory making of clover hay, as it is, indeed, for the satisfactory making of any hay; but it is far more important in the case of the clovers than for timothy, on account of the fact that the clovers need much more drying. The best hour in the day for cutting, as it appears to me, is late in the afternoon. Whatever the hour, it is essential to keep in mind the fact that in the curing of clover hay it should be handled but little after it begins to dry. It is generally well understood that too much handling as the crop dries results in the breaking off of the leaves and heads, which are the most valuable portion of the crop. Whatever the hour of cutting, then, the fact should be kept in mind that this crop should be tedded but little in curing. If cut late in the afternoon, the crop may be tedded once the following forenoon. If the weather is particularly fine, it will then be ready to rake and put into cocks late in the afternoon of the same day. If the clover is curing more slowly, it may be best to leave it in windrows over one night, and to turn these carefully with the fork the next forenoon, and to cock on the afternoon of the second day after cutting. The use of hay caps in curing clover hay should be more general. It is desirable to leave the clover in the cock for a number of days, sometimes as long as a week. The hay is coarse, and if exposed to rain it is badly damaged unless the cocks are protected by caps. When examination shows that the clover in the cock is apparently cured, it should be slightly opened and turned up from the bottom on the forenoon of a good day. It will then be ready to put in in the afternoon. Clover hay cured in this manner should hold substantially all its leaves and heads, and should cure of a bright green color. Such clover is one of the most valuable forage crops, whether for cattle, sheep or horses. Well-cured clover hay, popular opinion to the contrary notwithstanding, is a safe and valuable food for horses, which will need much less grain when fed such hay than when timothy hay is used.

CRANBERRY CULTURE.

BY LUCIAN J. FOSDICK, AUTHOR OF "FRENCH BLOOD IN AMERICA."

The cultivation of cranberries began during the nineteenth century, becoming an extensive industry in New England, New Jersey and Wisconsin during the last thirty years; and it has become the leading industry on Cape Cod, the soil there being particularly adapted to their growth.

Few people appreciate, while enjoying their Thanksgiving dinner, how much time, labor and money were spent in obtaining that small but important part of the feast, — the cranberry sauce.

Until of recent date cranberries were considered a luxury, but to-day they have become a staple necessity, and there is an ever-widening market for them.

The berry derived its name from the appearance of the flower, because, just before expanding into the perfect flower, the stem, calyx and petals resemble the neck, head and bill of the crane. Hence the name, "craneberry," which usage has shortened into the familiar "cranberry." The sub-family name, Oxycoccus, is derived from Oxus, — sharp, or acid, and Kokkus, — a berry.

Cranberries have been known to northern Europe for centuries, and are grown in Russia, Sweden and Great Britain. The berry is a native of Russia, Siberia, South America and North America. Its normal latitude for cultivation is 39° to 42° north.

The cranberry known as the "Large American Cranberry" is superior to any known varieties, and is highly cultivated in New England, New York, New Jersey, Michigan, Wisconsin, Minnesota and the Pacific coast States.

Cranberries were first cultivated on Cape Cod, Massachusetts, nearly a century ago; and of late years the harvested crop has netted the growers of the Commonwealth from one million to one and a half million dollars per annum.

According to statistics, cranberry culture occupies about 20,000 acres in the United States. The chief districts are located in Massachusetts, New Jersey and Wisconsin, but the northwest coast line of Oregon and Washington promises to become a great field for this agricultural industry.

There is a constantly increasing market for this fruit in the United States, and, without doubt, in the near future cranberries will be exported in larger quantities. The acidity of the fruit is especially healthful, particularly for people living in warm climates.

Land. — The land upon which the cranberry is cultivated is reclaimed swamps and bogs, which have formerly been considered of but little value. The right kind of soil is low, moist land, suitably drained, consisting of peat, muck and mould, or decayed vegetation, classified as alluvial deposit. Clay soil is unfit for the cranberry, and loam will grow weeds too readily. Brown or brush bog is best, because less labor is required to bring it to a state of cultivation, and this kind of bog land is usually free from grass roots. If wooded swamp land is used, trees should be cut at the roots, to tip out the stumps in felling, which can be burned or removed from the bog. Boulders will do no harm on a cranberry bog, but they take up room.

We prefer a bog open to the sunshine and winds, to one surrounded by high banks, as it is less liable to sun-scald and frost.

Sand. — Clear, sharp sand or gravel, free from clay or loam, is required, with which to cover the bog before setting vines.

Turfing. — After the removal of brush and trees, the surface of the bog should be turfed by cutting, with a turf axe, into pieces 12 by 18 inches, and then with a pulling hook the turf should be turned upside down. If there are bunches or tussocks they should be removed from the bog, also all coarse roots of trees and brush; but the turf should not be taken off, as it is the best feeder of the cranberry vine, being superior to muck, for it is not so cold and wet, and is more spongy. The turf should be cut with a turf hoe after it has been turned over, and the high places should be levelled.

Drainage. — Good drainage must be obtained, else during the growing season the berries will rot and sun-scald badly. To obtain good drainage, the bog should be ditched in sections adapted to its size and shape, six to twelve sections to the acre being the average. A shore ditch should be cut entirely around the bog. This is needed for two reasons: first, to cut off any underground water courses; and, second, to prevent upland growth encroaching on the bog. If the bog is sufficiently wide, a central ditch for the flow of water is desirable. The central ditch should be 4 feet wide, and of sufficient depth to carry the water from 12 to 18 inches below the surface of the bog. The shore and cross ditches should be cut 3 feet wide, and of sufficient depth to give proper drainage. After ditching, the sections should be graded and slightly crowned at the center, and the material thrown out in ditching may be used to fill up holes, and to make the proper levels.

Water. — A good water supply is essential to the successful cultivation of the cranberry. The supply may be obtained from a pond, reservoir or running brook, but must be under full control at all seasons of the year.

Stop-waters. — Stop-waters, or gates, in the brook and ditches will enable the grower to keep the water at the desired level, which should be varied according to the time and season. Early in the season 4 to 8 inches from the level of the bog, and later 10 to 15 inches, is a good average.

Sanding. — The next process in the preparation of a cranberry meadow is to cover the sections with clear, sharp sand or gravel, to the depth of 3 to 6 inches, 6 inches being none too much on the portions of the bog that are inclined to be soft and wet. The sand or gravel must be free from clay or loam. Sand will make a cold bog warm, and it will retain water while the surface is dry. It also retains the heat of the sun, causing the bog to be less liable to be affected by frosts and sun-scald than bogs not sanded. Sand also retards the growth of weeds, and affords the cranberry vine a better opportunity for growing.

When selecting bog lands to build into cranberry meadow, don't purchase when it is covered with snow or under water, unless you are familiar with the tract. Know the nature and condition of the land, and see that no one has a right of water flowage above or below your bog.

Vine Setting. — We are now ready to set out our cranberry vines. Care should be taken in the selection of varieties, there being over two hundred known varieties at the present time, all of which have not been cultivated sufficiently long to warrant their selection to any large extent. Vines which yield large crops of good-sized berries, of uniform dark color, are the ones to cultivate.

The "Early Black" is probably the most extensively cultivated. It is pear-shaped, a prolific cropper, will keep well if picked before too ripe, and will color well after picking.

The "McFarlin" is a native of Carver, Mass., a round, large berry, ripening medium early, coloring uniformly. It is a good cropper, and a good keeper when picked at the proper time.

The "Centerville" is a handsome, long berry, takes a high color, crops well, and can be harvested late. These three varieties, ripening successively, can be handled readily at harvest time.

Marked Varieties. — The marked varieties are distinguished in shape as pear, pointed, bugle, oval and round. Berries vary in the time of ripening, also in keeping qualities. Some berries will color well after they are picked, while others will not change from white to red unless left upon the vines to ripen. The cranberry is first green, then white, then it turns to pink, then red; and some varieties, when ripe, are so dark a red as to be almost black.

Vines should be set out evenly, to produce an even and regular growth; and, to accomplish this, a marker is used, made like a rake with five or more teeth, set 12 to 18 inches apart. This is dragged at right angles across the sanded bog. No care is needed to set the vines right side up; they will grow as readily one way as the other. Two inches above the sand is sufficient. More than three vines in a hill are liable to heat; and if they all thrive, the vines are too thick in the hills where over three are set. Hills should be 12 to 18 inches apart. Where the lines cross each other those that were made by the marker will indicate where to set the vines. The dibble is used in setting, to press the vines down through the sand into the soil beneath, leaving the vines just above the surface. Vines which do well will bear the second year, the third year a good crop may be expected, and the fourth year a full crop. With proper cultivation, they will do well for many years.

Cultivation. — Thorough weeding the first three or four years will assure a fairly clean bog. Brakes, ferns and rushes will grow readily in ditches and on the ditch banks, and should be dug out by the roots. If this part of the cultivation is neglected, they will grow so rank as to prevent the vines from bearing, and what few berries there may be on the ditch banks will be soft or green at harvesting. When the meadow is in bearing condition, all weeds should be removed by the time the vines are in bloom. On Cape Cod the blooming season is usually from June 10 to 25, unless winter flowage is continued late.

Walking over the meadow, after the berries have set, will destroy more or less of the fruit, and the weeding from this time to harvesting should be discontinued, removing only such weeds as may be reached by walking in the ditches.

Irrigation. — This is very essential to the successful cultivation of the cranberry. Too much or too little water are both difficulties to be avoided; or, in other words, water must be under control of the cranberry grower. The vine roots should be well fed with water up to the blooming period, but when the berries are formed the water should be kept lower.

Cranberry vines are fond of running water, and if the water supply is limited, the brook and ditches may be flushed out during a rain. Gravitation is the cheapest method of irrigating with water. But sometimes the pond is lower than the bog. In these cases a steam pump or windmill will overcome the difficulty.

Dikes. — In laying out cranberry meadows, in many instances it is necessary to build dikes. In case a meadow or bog is long, it might be economy to build a roadway dike across it, thus saving time and labor, and also by the same means reducing the depth of water to be carried at the time of flowing. This will be the case if the meadow has much of a fall. Providing the meadow is long, and has a fall of 5 feet, to cover properly the highest point of the bog, 7 feet of water will be required at the lower dike, so that this lower dike will need to be 9 feet high. By building one or more midway dikes, the volume of water may be reduced very materially, which is desirable for quick flowage and rapid drainage.

If dikes are to be built, they should have a broad base, below the center of which a 3-foot trench should be dug to hardpan. This trench runs lengthwise of the dike, and is filled with sand or gravel. The width at the bottom of the dike depends upon the depth of water to be carried in the pond or on the meadow at the time of flowage.

When the dike is to be used as a drive or roadway, the height will determine its width at the top. A dike 4 feet high, when constructed for this purpose, should be 14 feet wide at the top, and at least 18 feet wide at the base. No heavy team should be allowed to drive over it for at least six months after it is built, and then the wagon should have wide tires.

A dike should be built amply strong to withstand the pressure of water which it is intended to carry; and, if it is to be a reservoir dike, sand should be dumped off its bank on the reservoir or water side, to completely cover the turf. This sand covering will keep muskrats from burrowing into the dike, as the sand fills in wherever they try to burrow. The reservoir dike should be built at least 2 feet higher than high-water mark, for strong winds will cause the water to wash and slop against it. The outlet must be ample to admit of overflow in case of heavy rains and melting snow. Pulling plank should be set at the reservoir flume at the height water is to be carried.

The outside of all dikes should be built up with turf cut 12 by 18 inches, and some 12 by 24 for binders. All turf should be laid longest way crosswise on the dike, and all seams lapped, after the manner of laying bricks.

If the water is 6 feet deep at the flume, the dike should be not less than 8 feet high, 18 feet wide at the base, and narrowed to 10 feet at the top. This will allow 4 feet for the sloping of each side, which is none too much, even when good, tough turf is used for its banks.

When a dike crosses a meadow, no ditch should be dug nearer than 10 feet to its sides, else the great weight of the dike will crowd, and fill up the ditch, causing the dike itself to slump and cave. A crushed down dike is an eyesore, and little better than no dike for holding back water. If the dike crosses soft land, such as muck or mud, it should be spiled to hardpan lengthwise, in addition to the center filled trench. A thoroughly built dike will pay in the long run.

The flume through the dike must be carefully and strongly built. Some are built with stone, others with plank; but we prefer the Portland cement flume, built with a bulkhead so water can be handled at the top rather than from the bottom of the flume. An experienced man will be profitable to employ for this part of the work.

The Reservoir. — A pond or reservoir at the head of a cranberry meadow is of great value, to hold a reserve water supply for irrigation purposes during the dry months of summer, and also to enable the grower to flood his meadows when occasion requires.

Harvesting. — The best method of harvesting or picking cranberries is problematical, and must be determined by the individual grower.

Hand picking and raking were the original methods, and hand picking is still adhered to by many growers. On large bogs machine picking solves the problem of securing the crop during the harvest season, which on Cape Cod usually begins the last of August and continues into October.

Overripe berries will not keep well, and it is a mistake to pick the fruit when green, for, if marketed, it will bring a low price. If only good, high-colored, sound berries are marketed, the returns will be more satisfactory to the grower.

When the bog is to be picked by hand, a margin around the section is picked first, usually by men and boys, in the morning before the bog dries off sufficiently for regular picking. This is called ditch-row picking. These berries will be picked while the vines are wet with the morning dew, and only a few of them should be put into each picking box; when the berries are dry, the boxes may be filled up. Care must be taken to have the berries dry when packed in the storehouse, to insure their keeping qualities. Regular picking does not begin until the vines are dry.

After the margin is picked, the section is ready to be lined off. This, is done with a reel and line, two garden lines and a 3-inch ring. The men who line out the sections walk only on the margin, — which has previously been picked.

To harvest a 10-acre bog, yielding an average crop, about 50 hands are needed, besides a foreman, 2 men helpers, a tally keeper and a dumper.

Cranberries should be stored, dry, in a slatted bushel crate, with cleats on each end, to insure good keeping qualities previous to their being marketed; and while in the storehouse they should receive ventilation, but not be subject to draughts.

Where native help is scarce, bunk houses are built to accommodate the pickers during the harvesting season.

Bunk House. — Dimensions, 16 by 40 feet, with a partition through the center, so that one chimney is sufficient for the two apartments. In the extreme ends, in the center, are built two tiers of four bunks each, separated by matched board partitions. Each bunk is 4 feet wide, and is supposed to accommodate two persons. The space above the bunks is floored over with matched boards. The boys occupy the loft in one end of the bunk house, and the girls the loft in the opposite end. A bunk house arranged on this plan will easily accommodate 60 to 75 men, women and children.

Screen House. — A building with ample capacity for packing boxes, barrels, the harvested crop, and room to clean and pack berries, is essential. A dry, properly ventilated cellar in this building is especially desirable, in which to store the harvested berries previous to packing and shipping to market.

Turkey strutting in the lane,
Thinks he's very fine;
Cranberries gleaming in the sun,
How like rubies shine.
Mince pies sitting in a row,
Oysters from the bay;
What a glorious feast we'll have
On Thanksgiving day.

Fall Work. — Previous to the ground freezing up for winter, all weeds should be removed from the bog; dikes and flumes should be examined, to see that all is secure before the bog is flowed.

A rank growth of vines will not yield a good crop of berries, and what there are will be late in ripening, and subject to rot if the season is hot and wet. Under these conditions it is well to resand the vines with 1 to 2 inches of sand. Vine sanding is done on the same principle as the sanding of new bog, with one exception. Instead of dumping the sand on the bog, each wheeler brings his shovel on the wheelbarrow load, and spreads the sand from his barrow. To accomplish this a plank runway is laid from the sand pit to the bog. Upon this runway men with wheelbarrows bring the sand as directed by the foreman, who attends to moving the runway as the sanding progresses. Sanding is often done after ice forms on the bog. The only objections to this are, that the vines needing sand cannot be so readily seen, and sometimes when ice breaks up it drifts with the sand on it, carrying it to parts of the bog where it is not needed, thus distributing the sand unevenly.

Winter Flowage. — For the protection of cranberry vines during the cold months, flowage should take place just prior to the freezing up of the ground. This prevents winter-killing of vines, which is liable to occur during severe winters, the same as grass will winter-kill. It also prevents the throwing of vines by the action of freezing and thawing.

Should any portion of the bog be less than 12 inches under water, it will be well to keep a sharp lookout to the outlets after the ice forms, and prevent any lifting of the ice by heavy rains or sudden thaws, which will pull the vines, where frozen into the ice.

Late flowing in the spring will retard the growth of the cranberry vine, and thus it can be carried beyond the usual frost-killing season. Water is kept on by some growers on the Cape until early summer, to avoid the late spring frosts; but this will shorten the growing season, and cause the berries to ripen late in the fall. Seasons will vary, but on Cape Cod from the last of November to the last of April is a good average period for bog flowing.

When there is an ample supply of water, the grower, to kill off injurious insects, will resort to a twenty-four hours' flowing of his bog during a rain or cloudy weather, as the sun will scald berries that are under water. If a bog is seriously infested with worms or insects, to the destruction of the fruit crop, it may be desirable to flood the meadow all summer, and sacrifice one season's crop.

March winds are injurious to cranberry vines, as this is usually a thawing and freezing month, and a covering of water will protect them.

A fruit crop is sometimes saved from fall frosts by flowing. This can be done when there is an ample supply of water and good drainage. Water must be handled quickly, in order that the meadow may be dry at time of picking; also, to prevent the berries from sun-scald.

Drawing Off. — When the winter flowage of water is drawn off, a rainy spell should be chosen. More or less slime, etc., will form on the bog and vines; and if the water is drawn off during a storm, the rain will wash the vines, and the exposure to the air at this time, minus the sun's rays, is very beneficial.

Packing and Shipping. — The packing season usually begins soon after picking, following soon after the fall fruits are out of the market. Small shipments are made during the picking season, the berries being cleaned and packed in the morning, while the bog is drying off, and also on rainy days.

Berries stored in the storehouse at a cool temperature, if brought to a much warmer temperature in the packing room, will become wet. This is often spoken of as the sweating process, which term is hardly correct, for the cranberry skin is waterproof. To demonstrate this fact, submerge cranberries in water for days, and they will be as fresh as when picked. When berries are wet, under the conditions mentioned, it is due to the process of condensation. Berries should never be packed in a wet condition. To avoid this, the packing house should be kept cool, and then, if berries become wet, it is best to discontinue packing until the atmosphere becomes cool and dry.

Berries are poured from the picking or storage boxes into the hopper of the separator, which blows out the vines and separates the greater part of the poor from the good berries. From the separator the berries go to the screens, and are carefully picked over by women, four or five usually working at a screen.

The shipping package has been, to a great extent, the 100-quart barrel, but the two-compartment crate (holding 32 quarts, dry measure) is the proper shipping package for cranberries. In fact, many of the commission houses manifest their preference for the crate package by re-packing from barrels into crates. The crate package will keep the berries in the best possible condition, it is easily handled, and it requires for equal holding capacity less storage room than a barrel.

Cooking. — As cranberries contain such acute acids, there is no fruit that will so quickly act upon tin, iron or brass, when brought into contact. Hence, always cook cranberries in earthen-lined kettles, granite, agate ware, or, still better, in aluminum kettles, which are now reasonable in price, are light to handle, will not tarnish or discolor the sauce, and do not easily scorch it. Never allow any article of food containing cranberries to stand in anything but earthen or glass dishes. Granulated sugar should always be used, as the poorer qualities of sugar and molasses destroy the flavor of this delectable berry.

God bless the man who sows the wheat,
Who finds us milk, and fruit, and meat;
May his purse be heavy, his heart be light,
His cattle, and corn, and all go right.
God bless the seeds his hands let fall,
For the farmer, he must feed them all.

Estimated Cost of building Cranberry Meadow.

Cost per acre for land,	$10 00
Turfing, grading, ditching and sanding,	200 00
Six barrels vines, at $5 per barrel,	30 00
Setting out of vines,	16 00
	$256 00

Nothing is allowed in this estimate for tools, building of dikes, flumes, roadways, or for buildings. The cost will to a great extent depend on the conditions which exist naturally, the manner in which the bog is built, and the foreman having charge of the building of the bog. The estimate given is based upon labor at $1.50 per day of 9 hours.

It is not unreasonable to expect that a good piece of bog, properly built and vined with good varieties, receiving proper care, will give an average yearly yield of 60 to 75 barrels of cranberries per acre. Estimates, based upon statistics gathered from many bogs, for a term of years, have been given by a large grower as about 32 barrels per acre.

In the cultivation of cranberries, there are many things which will interest the thoughtful and diligent man. The author has made no attempt to write a glowing account, but his purpose has been to encourage the intelligent cultivation of waste places possessing great fertility, which, under right management, can be made to produce paying crops.

PEACH CULTURE.

BY F. A. WAUGH, PROFESSOR OF HORTICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

Interest in peach culture has evidently increased very greatly in New England during the last few years. In spite of unusually severe freezes during winters of 1902–03 and 1903–04, there have been several good crops gathered during the last five years. In most cases reasonable profits have been made, and in some instances the returns have been so large as to be fairly remarkable.

There is every reason to believe that the peach business in New England will continue to be an attractive commercial proposition. The uncertainty of the winters is of course a drawback, but aside from this the situation is altogether favorable. We have directly at hand the finest market on this continent. The difficult problems of long-distance shipment, refrigerator car service, icing charges, etc., which confront the southern peach grower, are entirely eliminated from our calculation. Not only can our fruit be put into market much more cheaply and quickly, but on that account it can be presented to the customers in much better condition. For all these reasons the net prices realized by New England peach growers are bound to be very much greater than those received by the peach growers of the south. It thus seems altogether probable that the investment in commercial peach growing in New England will be substantially increased during the next few years.

Peaches may be grown in all parts of Massachusetts. They may be made commercially successful in the majority of towns in the State. In the highest localities and in some of the towns along the coast peach growing cannot be safely undertaken on a large scale. In every locality it is advisable to plant peach trees only on land especially suited to this crop.

Soils and Exposures.

There is a general understanding that peaches should be planted on a north or northeastern exposure; that is, upon land sloping towards the north or northeast. This rule rests upon the fact that land sloping towards the south or southwest is necessarily warmer, and the trees start into growth earlier in the spring. It depends also on the further assumption that the trees will blossom enough earlier on the southeastern slope so that the crop will be caught by late frosts in certain years. It must be said, that while this assumption may prove true in a few cases, it will not hold good for the majority of localities in Massachusetts, — at least not for Worcester County and the territory from there to the western line of the State. Old peach growers who have observed this matter closely assert that the peach buds in western Massachusetts are never killed by late frosts. This observation agrees entirely with the experience of the writer, although that experience covers only four years of residence in the State. Peach buds are often injured, and, indeed, entire crops are lost; but the injury is due to heavy freezing during the winter, and not to the blossoms being caught by late frosts in the spring.

These observations have an important bearing on the question of exposure. If it is a fact that the crop never suffers from late frosts, then the selection of a north or northeast slope is of much less consequence. On the other hand, there are some real advantages in a warmer exposure. We have none too much summer heat in most parts of Massachusetts for the proper ripening of the peach crop. The trees thrive better in warm situations, while the crop of fruit ripens better, takes a better color and reaches a higher quality.

The ideal soil for peaches is found on some of our warm, gravelly hilltops and hillsides. The small drumlins, made up of loose glacial deposit, found in the Connecticut valley region, are apt to be especially good. Even sandy soils are excellent for growing peaches, unless the sand is too fine or unless the drainage is bad. Heavy, cold clay soils are entirely unsuited to the peach tree. In this connection it may be well to point out that peach trees may be to some extent adapted to clay soils of fairly heavy texture by being propagated on plum roots. The plum is naturally adapted to a stiffer soil than the peach. The peach tree may be readily budded on to the plum root, and, if the proper variety of plum is chosen, the union is a good one and long-lived. The Myrobalan plum — the one usually used in this country as a budding stock — is probably the poorest one of all for the propagation of peaches. The old-fashioned "horse plum," which formerly was used in some nurseries, is much better. The St. Julien plum, used in many European nurseries, is satisfactory, and can always be secured commercially, although it costs considerably more than the Myrobalan. The native Americana plum, now extensively grown in western nurseries, makes an admirable stock for peaches, and is well adapted to our Massachusetts soils. All these plum stocks have more or less of a tendency to dwarf the peach tree, but this is an advantage rather than a disadvantage. The fact that the peach trees are thereby brought earlier into bearing increases the chances of securing a crop before the tops are frozen back; and the fact that the smaller trees may be planted more thickly on the ground is an economy of land.

There are no nurseries in the United States, so far as the writer knows, where peach trees are being commercially propagated on plum roots. There probably never will be until a strong demand arises for that kind of peach trees, because it necessarily costs more than to propagate them in the usual way. These suggestions, therefore, are practically available only to those men who like to bud their own trees. The majority of us, who are compelled to depend on the nurserymen, will still be satisfied with peach trees on peach roots.

Planting the Orchard.

The soil must be in prime condition before the trees are set. This is a rule which applies to all fruit trees, but more emphatically to the peach than to any other. The land should be in prime cultivation, deeply plowed, well drained and in good physical condition, and should contain a reasonable amount of available fertility. Tile drainage, always a safe undertaking on high-class agricultural land, is the means of improvement advisable on many tracts designed for peach culture.

It is an open question whether fall planting or spring planting is better. Under certain circumstances one will succeed better than the other; but given other circumstances, and the other will have the preference. As a general thing, it may be said that fall planting is better when all conditions are thoroughly favorable. If the soil is in first-class condition, if the trees are fresh and sound, if the planting is well done and if a favorable winter follows, then fall planting is likely to show a positive advantage over spring planting. On the other hand, if the soil is not well drained, if the trees are in poor condition, if the planting is carelessly done or if it should be followed by a severe, freezing winter, there is likely to be more or less damage, as a result. On the whole, the writer is inclined to favor fall planting for the experts who have everything their own way, and who are able to control conditions in their favor; but to advise spring planting for men of less experience, or for those less favorably situated.

Good peach trees fit to plant must be one year old. Two-year-old trees are seldom worth the trouble of planting out. The so-called "June buds," which technically pass as one-year-old trees, but which are really something less, are not to be recommended; they should be bought only as a last resort.

Good trees should be of medium to large size. Small, light trees are inferior, while the very largest ones are difficult to handle, and are not proportionately valuable. Amongst nurserymen trees are usually graded according to the size. One grade runs 4 to 5 feet, the next 5 to 6 feet, the next grade 6 to 7 feet. As a rule, the writer prefers trees of the 5 to 6 feet grade. Splendid peach trees can be grown in Massachusetts nurseries; but, as a matter of fact, very few of them are grown here, chiefly because they can be grown very much more cheaply in States farther south. It has been the experience of the writer that these southern-grown trees are just as good for planting in Massachusetts as those grown in the neighborhood.

When the ground is all prepared and ready, the rows furrowed out and the holes dug, the trees should be taken out of the soil where they have been heeled in and prepared for planting. This preparation. is made by cutting them back with the pruning shears. All broken and straggling roots should be first cut off. Some growers now practise cutting all the main roots back to a length of 3 or 4 inches. Perhaps this is going a trifle too far, but at any rate one need not take the trouble of digging wide holes in order to plant out very long roots; it is just as well to cut them back a reasonable amount.

There is room for a greater difference of opinion concerning the best pruning for the top of a peach tree about to be planted. Three methods may be mentioned: (1) all the branches may be cut back to a length of four or five inches; (2) all the branches may be cut off close to the main stem, leaving a straight whip; (3) all the branches may be cut off, and the main stem cut back to any desired height, from 8 inches and upward. The writer very much prefers the method last described, and would cut back the main stem to a height of not more than 20 inches, preferably not more than 16 or 18 inches. This looks like very severe treatment, since in many cases it would leave less than one-fourth or one-eighth of the tree as it originally comes from the nursery. Nevertheless, the results, as shown in the first year's growth of the tree after planting, are always gratifying. A tree cut back in this way throws out a few side shoots, usually symmetrically placed about the trunk, and these make a very strong growth during the first year. There is thus formed a fine framework upon which to build the future fruit-producing structure. Peach trees, on the other hand, which are planted out without this severe cutting back, push into growth from a larger number of buds. Dozens or even hundreds of new shoots start out, all of which make a weak growth. There are no strong, vigorous arms formed, which may become the framework of a permanent tree. Of course a great deal depends upon the future management of the peach tree top, but a good deal also depends on beginning right.

Planting Distances.

The proper distance apart for planting peach trees depends more or less on circumstances, especially on the system of culture and pruning which is to be adopted. If the trees are to be rigorously headed back, they may be safely planted at a distance of 12 feet apart, or even 10 feet. If they are to be allowed to grow without heading in, they should be planted 20 feet apart, especially if the soil is naturally rich. There is often a good deal of unnecessary argument over this question of planting distance. The question is really not one to be decided by itself; it is altogether relative, and is to be settled only with reference to the system of management which is to be adopted in the orchard.

CULTIVATION.

There has been some argument in the last few years as to the best systems of managing apple orchards, some respectable fruit growers maintaining that the best practice required the trees to be kept in sod. Practically nobody recommends sod management for peach orchards, however. While there are isolated instances of successful peach trees standing in grass, they are so rare as to be negligible. The peach tree is a gross feeder, a rank grower, and requires large quantities of plant food and moisture to develop its fruit crop. These requirements are best met by a system which introduces thorough cultivation during the period of growth.

There are many systems of culture, differing more or less widely from one another; but an ideal system presents about three stages, as follows: (1) a reasonably thorough plowing of land early in the spring; (2) frequent surface cultivation up until midsummer; (3) the growing of a cover crop, which remains on over winter and is plowed under the following spring.

The first cultivation in the spring has been spoken of as plowing. It may, in fact, be accomplished with a good plow, a steady team and a good driver. After the centers have been plowed out between the rows, it is possible to get somewhat nearer the trees by the use of a one-horse plow. However, on most lands and under most circumstances the best implement for the spring plowing is a good, sharp spading harrow; even a disk harrow will do very well on light soils. If this implement has the convenient extension now provided by most manufacturers, it becomes very easy to run up close to the trunks of the trees. In using the disk or spading harrow, it is best to go across the land in both directions. This may be necessary also with the plow, although it is not so conveniently done.

The summer cultivation should be given with much lighter tools, running only on the surface of the soil. A light, sharp smoothing harrow is best of all where the ground is mellow and in good condition. The Acme harrow is also excellent for this kind of work. On gravelly or somewhat stony soils the spring-tooth harrow is best of all. Again, if the soil is inclined to bake or is naturally hard, the best results can be secured with the disk harrow. This summer cultivation should be frequent; it should be given at intervals not greater than ten days; once a week is still better. The drier the weather, the more frequent should be the cultivation. It is a great mistake to time this work by the growth of weeds. This summer cultivation is not intended to keep down weeds, but to conserve moisture and promote the liberation of plant food.

The vigorous growth of the trees ceases about July 1; thereafter the wood ripens and the fruit buds mature for the following year. If there is a crop of fruit on the trees, of course it also has to be brought forward to maturity. As a rule, however, the demands for moisture on the part of the tree are not so great as during May and June. Long experience and thorough scientific experiments agree that cultivation may be profitably remitted after about July 1. Experience has shown, however, rather emphatically, that it is unwise to allow the land to stand bare for the remainder of the year. However, the requirements are all reasonably well met by sowing a cover crop at the time of the last cultivation.

A cover crop in an orchard performs several useful functions. It holds the soil from washing during winter and spring months, it takes up fertilizer and prevents leaching, it renders a certain amount of plant food available storing it for future use, it may collect a considerable amount of nitrogen from the atmosphere; but perhaps its most important office is in keeping the soil supplied with humus. This last benefit is accomplished when the plants are plowed under in the spring.

Various crops have been recommended for covers in peach orchards, but some experience is required to select the one best adapted to a given soil and climate. As a rule, preference should be given to leguminous crops which collect nitrogen from the atmosphere. The various clovers, especially those of larger growth, make fairly good cover crops. The vetches are excellent. The winter vetch is especially good, its chief drawback being the high price of the seed. Cow-peas are a favorite crop in southern latitudes, but are not generally satisfactory in Massachusetts. Early maturing varieties of soy beans have been found amongst the best of all cover crops in our experiments. A very excellent cover can be secured by sowing a mixture of Canada peas and barley. Buckwheat makes a first-class cover crop, and has the advantage of germinating well. Winter rye is sometimes used, and oats are better than nothing.

In planting any of these cover crops the seed should be sown in large quantities, in order to make a thick mat. We have found it best, in sowing such crops as soy beans, to drill them in, making the rows about 2 feet apart. When this is done we plant the cover crop two weeks earlier than we would otherwise, say about June 10 to 15. The cultivator is then run once or twice, sometimes even three times, between the rows of soy beans after they come up. In this way the cover-crop period and the cultivation period overlap one another to some extent, and this is found to be an advantage.

FERTILIZERS.

If a system of cover cropping is consistently followed, and if a good growth of soy beans, clover or other leguminous crop is secured from year to year, there will be no need of large applications of nitrogen; at any rate, only small quantities of nitrogen will be required on fairly rich soils. It is not difficult to estimate the need for nitrogen by watching the growth of the peach trees. If the trees make an average growth of 18 inches or more every year, and if the foliage is large, dark colored and slightly wrinkled, one may feel satisfied that there is nitrogen enough available for the trees. On the other hand, if the growth is less than 1 foot annually, if the foliage is yellow and drops early from the trees, it is plain that more nitrogen should be given. The simplest and cheapest method of applying this element of plant food is doubtless in the form of nitrate of soda. Our experience has shown that this chemical is entirely acceptable to peach trees, and that it produces excellent results. It should be applied in quantities of 100 pounds to the acre, just after the leaves come out. In case the trees are carrying a crop of fruit, and especially in case they are not in most vigorous health, it will be well to make the application of nitrogen a little heavier, and to put it on in two dressings. The first should be given just after growth starts, and the second one when the peaches are a little larger than robins' eggs.

Dr. Van Slyke suggests the following formula for fertilizing peach trees: nitrate of soda, 50 pounds; dried blood, 100 pounds; cottonseed meal, 200 pounds; acid phosphate, 600 pounds; muriate of potash, 240 pounds; this makes a total of 1,190 pounds, which should be the maximum application for an acre. As a rule, about half that amount would be a sufficient annual application for soils of reasonable fertility.

There is a strong prejudice against the late application of fertilizers on peach trees, and against late cultivation, on the ground that it induces a strong, soft growth of wood in the latter part of the year. The theory is that this wood is frozen back during the winter, and the tree thereby injured. While no direct experiments have been made on this point, it must be said that our rather extensive observations at the Massachusetts Agricultural College have strongly discounted this theory. In our experience, the trees which make the most vigorous growth are the ones which best withstand the heavy winters.

Pruning.

The peach orchard requires more thorough and regular pruning than the apple orchard, and this is saying a good deal. This matter should have attention as often as once a year. In fact, the writer is fully convinced that the best results in managing a peach orchard cannot be secured with less than two general prunings annually. One of these should be given in early spring, about March 1, and the other in midsummer, usually during the last half of June. Summer pruning, rightly conducted, is very advantageous in controlling the growth of peach trees.

If the top of the tree is rightly formed at the beginning, as explained in the paragraph on planting, there will be no great difficulty in forming a strong symmetrical head on every peach tree in the orchard. As soon as the tree is formed and fruitage begins, some regular system of management should be adopted and consistently pursued. There are two general methods. According to the first, the tree is allowed to grow in every direction as far as its natural habit leads it, pruning being directed to the business of keeping the center opened and the branches full. A tree well grown in this manner, the formation of too many large low branches being prevented, takes on something of a vase form. From this fact it has often been called the vase form pruning. According to the other method, the tree is frequently and sometimes vigorously headed back. Branches are cut off at the sides and at the top. This heading-in requires some judgment. If carelessly and improperly done, the results are bad; if intelligently followed, however, the method is all that could be desired.

Vigorous, healthy peach trees in full growth and well set with fruit buds should be headed back at a spring pruning (if the heading-back method is to be followed), leaving just enough one-year-old wood to carry a reasonable crop of fruit. In any year when the fruit buds have been killed by freezing, the heading back may be somewhat more severe; at such times it is practicable to cut back to two-year-old wood; in some places it is safe to cut even into three-year-old wood. If trees are weak and unhealthy, vigorous heading back is still more desirable. Vigorous heading back in this connection, however, does not mean the removal of the entire top of the tree, as is sometimes practised under other conditions for other purposes.

The summer pruning of the trees, already referred to, should be directed to the removal of excessive growth. Any tree which is growing is apt to choke its head with strong shoots, which shut out the light from the interior, prevent the proper coloring of the fruit, and prevent also the formation of fruit buds for the succeeding crop. The slight check which is given by the removal of green shoots during the summer is advantageous also in promoting the formation of fruit buds.

The thinning of the fruit may be regarded as a sort of pruning. If pruning is practised, as advised above, a certain amount of thinning of the fruit results as an incidental benefit. Whether summer pruning is given or not, considerable thinning of the fruit is advisable in any year when the crop sets reasonably well. Experience everywhere has shown that money expended on thinning pays a large profit.

Diseases and Difficulties.

The great danger which a peach orchard in Massachusetts always runs is that of heavy winter freezing. The peach grower must take this chance into account when he starts into business. In case a heavy freeze occurs, and the trees are injured, the damage can be repaired somewhat by proper management. Extensive experiments on this subject, conducted by the Hatch Experiment Station of the Massachusetts Agricultural College, have shown that moderate heading in of the trees after a heavy freeze gives best results. This should be followed by thorough cultivation, and the application of a small amount of nitrate of soda. Trees once severely frozen, however, will never fully recover.

The curculio is often spoken of as a serious pest in peach orchards. Its ravages are easily overestimated. As a matter of fact, this insect makes little impress on any good commercial crop. Those fruits which are punctured come off in the June drop or are removed at thinning time. The percentage of otherwise good peaches lost from this insect is usually so small as to be entirely negligible. Where the insects are really bad, it may be worth while to jar them off the trees and burn them.

In some years, especially when the crop is heavy and the ripening season is warm and moist, there is serious loss from ripe rot of the fruit. After this trouble makes its appearance there is very little to do except to pick the fruit early, and get it into a cool room as quickly as possible. The rot can be to some extent prevented with thorough spraying with Bordeaux mixture. For this purpose, spraying should be done early, even before the buds open in the spring.

The peach yellows is still with us, although there is less said about it than formerly. The best and safest practice is to dig up and burn immediately every tree which is found infested with this disease.

The San José scale is unquestionably the most serious pest which the peach grower has to deal with. This vile insect seems to have a special preference for peach trees. Various methods of fighting the San José scale have been tested and widely discussed during the last few years. It would require an entire bulletin to set this matter forth in any detail. It may suffice for the present to say that the lime-sulphur spray has been found altogether the most efficient remedy under New England conditions thus far.

Handling the Crop.

There are all sorts of ways of selling peaches. In our experience, the package in which the fruit is sold makes a great difference in the price. For fancy, especially early, varieties, we find a two-quart basket with bale the most successful. To some extent we have sold peaches locally in the four-quart till-baskets, such as are shipped six in a crate from Georgia. As a rule, this four-quart basket does not give the best satisfaction in local markets. For shipping, especially to considerable distances, the four-quart basket packed six in a crate is very satisfactory. For local markets and short shipments undoubtedly the favorite basket is the half-bushel Jersey form. As a rule, our markets prefer the real half-bushel basket, holding sixteen quarts; although in some towns the short basket, holding fourteen quarts, sells equally well. It is important to secure a good supply of clean, well-made baskets early in the season, when one has a crop of peaches in sight. The price on baskets always goes up stiffly during the peach-picking season, and it is very distressing to run out of baskets altogether.

VARIETIES.

There are a great many varieties of peaches offered by the nurserymen, but a small selection will answer for home use, and a still smaller list will be better for market. Attention should be called to the fact that good, white-fleshed peaches are becoming more popular. This is partly due to the introduction of new white varieties of high quality, such as Greensboro, Hiley, Waddell, Belle of Georgia. The yellow-fleshed Elberta has come in with the other new introductions, and has promptly taken its place as the most profitable of all peaches.

In planting for family use, every one should choose his own favorite varieties. As a reasonably good selection for family use, however, we may name the following: Greensboro, Early Crawford, Mountain Rose, Foster, Belle of Georgia and Crosby. This will give a succession throughout the season.

For market purposes the following varieties have been found profitable: Greensboro, Mountain Rose, Elberta, Crawford Early and Crawford Late, Oldmixon.

The following list of varieties comprises the most popular old sorts and the most promising new ones : —

Belle of Georgia. — A very profitable peach in the south, and fairly successful in New England. To some extent this takes the place of Oldmixon, coming in about the same season. The tree is hardy. The fruit is white, freestone, of excellent quality.

Carman. — An excellent white peach for family use or local market. Large, round, white with bright red cheek. Tree hardy.

Chair's Choice. — Tree hardy. Fruit oval, deep yellow, freestone. Quite late, coming just after Late Crawford.

Champion. — Strong, upright tree, with hardy fruit buds. Prolific. Fruit round, large, creamy white with pink cheek; flesh tender and sweet. Of best quality.

Crawford Early. — Tree small, medium size, moderately productive. Fruit large, oblong, yellow, freestone, good quality. Midseason. A good peach, and worth planting.

Crawford Late. — Tree large, spreading, very hardy. Fruit very large, yellow, freestone. Late. This has been the favorite peach in Massachusetts for years, but as a market variety it is far less profitable than Elberta.

Crosby. — Tree willowy, spreading and very hardy. Fruit round, yellow, freestone, of high quality.

Elberta. — Tree strong, stocky, spreading. Very productive, — in fact, the most productive peach grown. Fruit large when properly thinned, oblong, yellow with red cheek, freestone. Quality rather poor. This is one of the most profitable peaches grown, but the quality is not all that can be desired.

Foster. — Fruit large, deep yellow, sometimes almost red, of high quality.

Fox. — Tree strong and hardy. Productive. Fruit oval, white with blush, sweet and high flavor.

Greensboro. — This is a fine white peach with a red cheek, of good size and quality, and the earliest variety of any consequence to ripen here. It has proved very satisfactory and profitable at the Massachusetts Agricultural College.

Hiley. — Another excellent white peach of the modern style. Midseason, or a little ahead of Mountain Rose.

Mountain Rose. — Strong, upright tree. Fruit white fleshed with rosy cheek. Best quality. Excellent for home use or local market.

Oldmixon. — This has always been a favorite white peach in New England, but is now largely superseded by Belle of Georgia and other earlier and more reliable white varieties. Tree large, moderately prolific. Fruit white, freestone, tender, rich. Good variety.

Stump. — An old-fashioned white peach, preferred by some. Desirable on account of its lateness, coming at the end of the season.

Triumph. — A very hardy tree, bearing abundantly. Fruit small, yellow, of poor quality. Should not be planted.

Waddell. — A good white freestone peach, moderately early, medium size, good quality. Fruit buds hardy.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH

MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1906.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When incorporated.	Amount originally raised by Contribution. (R. L.124, Sects. 1 and 3.)	Amount now held invested as Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	1881	$1,002 32	[1] $8,127 66	$8,121 97	$8,127 66
2	Barnstable County, ...	1844	1,740 00	[2] 9,375 00	9,375 00	9,933 31
3	Blackstone Valley, ...	1884	3,000 00	[3] 4,500 00	4,500 00	4,500 58
4	Deerfield Valley, ...	1871	4,094 01	[4] 9,200 00	9,450 00	9,573 64
5	Eastern Hampden, ...	1856	3,000 00	[4] 7,000 00	7,000 00	7,148 11
6	Essex, ...	1818	4,527 20	[5] 23,476 42	23,476 42	23,476 42
7	Franklin County, ...	1850	3,768 00	[6] 11,030 50	11,025 50	11,030 50
8	Hampshire, ...	1850	3,255 26	[3] 5,150 00	5,150 00	5,173 58
9	Hampshire, Franklin and Hampden, ...	1818	8,141 29	[7] 10,707 21	10,707 21	10,707 21
10	Highland, ...	1859	3,262 00	[4] 3,000 00	3,262 00	3,302 45
11	Hillside, ...	1883	3,113 32	[7] 5,840 85	5,840 85	6,095 74
12	Hingham (Agricultural and Horticultural), ...	1867	17,406 15	[8] 5,000 79	5,000 79	5,000 79
13	Hoosac Valley, ...	1860	2,006 00	[3] 16,500 00	16,500 00	17,723 32
14	Housatonic, ...	1848	6,335 33	[9] 24,111 59	24,261 59	24,111 59
15	Marshfield (Agricultural and Horticultural), ...	1867	3,755 33	[3] 14,500 00	14,500 00	14,500 00
16	Martha's Vineyard, ...	1859	4,552 17	[10] 4,139 10	4,139 10	4,340 71
17	Massachusetts Horticultural, .	1829	525 00	[11] 564,524 70	844,102 08	844,102 08
18	Massachusetts Society for Promoting Agriculture,[12]	1792	–	–	–	–
19	Middlesex North, ...	1855	3,000 00	[1] 32,363 91	31,800 00	32,363 91
20	Middlesex South, ...	1854	3,000 00	[4] 12,000 00	12,200 00	12,226 22
21	Nantucket, ...	1856	3,500 00	[4] 3,200 00	3,200 00	3,210 01
22	Oxford, ...	1888	4,400 00	[7] 9,538 92	9,538 92	9,538 92
23	Plymouth County, ...	1819	9,550 00	[13] 1,618 07	1,618 07	1,631 37
24	Spencer (Farmers' and Mechanics' Association), ...	1888	4,034 00	[3] 10,350 00	10,350 00	10,459 34
25	Union (Agricultural and Horticultural), ...	1867	4,447 23	[3] 9,000 00	9,000 00	9,199 13
26	Weymouth (Agricultural and Industrial), ...	1891	10,270 00	[3] 11,270 00	11,270 00	11,355 14
27	Worcester, ...	1818	7,730 00	[14] 88,910 00	90,374 50	90,374 50
28	Worcester East, ...	1890	2,296 23	[1] 9,575 70	9,575 70	9,575 70
29	Worcester Northwest (Agricultural and Mechanical), . . .	1867	3,400 00	[3] 13,600 00	13,600 00	13,735 11
30	Worcester South, ...	1855	3,127 40	[7] 11,100 00	11,100 00	11,100 00
31	Worcester County West, . . .	1851	3,175 00	[3] 13,600 00	13,600 00	13,710 88
			$135,413 24	$952,310 42	$1,233,639 70	$1,237,327 92

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[1] Invested in real estate, cash, crockery, tables, etc.

[2] Invested in real estate, bonds and bank funds.

[3] Invested in real estate, crockery, tables, etc.

[4] Invested in real estate.

[5] Invested in real estate, stocks and bank funds.

[6] Invested in real estate, notes, stocks and cash.

[7] Invested in real estate, bank funds, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1906.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,716 69	–	–	–	–	$405 28	$5 69	$1,745 13	1
7,500 00	–	$500 00	$1,375 00	–	–	1,375 00	998 25	2
4,400 00	–	–	–	–	100 00	58	1,747 50	3
9,200 00	–	–	–	–	250 00	123 64	–	4
7,000 00	–	–	–	–	–	148 11	7,051 02	5
15,300 00	–	7,805 00	–	–	200 00	171 42	11,877 95	6
10,000 00	$25 00	1,000 00	–	–	–	5 50	5,440 00	7
5,000 00	–	–	16 58	$7 00	150 00	–	2,000 00	8
9,000 00	–	–	1,207 21	–	500 00	–	2,200 00	9
3,000 00	–	–	–	–	262 00	40 45	–	10
5,000 00	–	–	490 85	–	350 00	254 89	–	11
2,500 00	–	–	1,431 18	–	1,000 00	69 61	–	12
16,000 00	–	–	–	–	500 00	1,223 32	10,000 00	13
22,000 00	–	1,185 29	–	–	425 00	501 30	2,050 00	14
14,000 00	–	–	–	–	500 00	–	2,450 98	15
2,750 00	150 00	–	989 10	8 00	250 00	193 61	15 00	16
562,534 22	–	258,488 50	–	3,488 76	9,857 38	9,733 22	6,700 00	17
–	–	–	–	–	–	–	–	18
31,500 00	–	–	–	–	300 00	563 91	23,100 00	19
12,000 00	–	–	–	–	200 00	6 22	7,800 00	20
3,000 00	–	–	–	–	–	10 01	606 09	21
8,300 00	–	–	1,000 00	–	200 00	38 92	–	22
–	–	–	1,579 07	–	39 00	13 30	–	23
9,400 00	–	–	–	–	950 00	109 34	2,150 00	24
8,000 00	–	–	–	8 00	1,000 00	191 13	1,331 50	25
11,000 00	–	–	–	–	270 00	85 14	2,400 00	26
58,000 00	–	–	30,910 00	–	1,464 50	–	500 00	27
7,235 85	–	–	–	–	75 00	2,264 85	–	28
13,000 00	–	–	–	–	600 00	135 11	4,050 00	29
10,298 10	–	–	501 90	–	300 00	501 90	1,920 80	30
12,600 00	–	–	–	–	1,000 00	110 88	700 00	31
$887,234 86	$175 00	$268,978 79	$39,500 89	$3,511 76	$21,148 16	$17,877 05	$99,034 22	

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[8] Invested in real estate, bank funds, cash, crockery, tables, etc.

[9] Invested in real estate, stocks, bonds, cash, crockery, tables, etc.

[10] Invested in real estate, notes, bank funds, crockery, tables, etc.

[11] Invested in real estate, library, furniture, bonds and other securities.

[12] Represented on Board by special enactment, and makes no returns.

[13] Invested in bank funds, cash, crockery, tables, etc.

[14] Invested in real estate and bank funds.

FINANCIAL RETURNS OF THE INCORPORATED SOCIETIES

	SOCIETIES.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	–	$170 13	$1,575 00	$1,317 95	$600 00	–
2	Barnstable County, ...	$151 25	47 00	800 00	7,233 76	600 00	$12 00
3	Blackstone Valley, ...	–	122 50	1,825 00	1,063 30	600 00	–
4	Deerfield Valley, ...	–	–	–	2,153 11	600 00	–
5	Eastern Hampden, ...	–	566 22	6,484 80	4,747 44	600 00	–
6	Essex, ...	–	–	11,877 95	2,666 18	600 00	–
7	Franklin County, ...	–	40 00	5,400 00	7,669 59	600 00	–
8	Hampshire, ...	–	–	2,000 00	1,580 56	600 00	–
9	Hampshire, Franklin and Hampden, ...	–	200 00	2,000 00	2,200 00	600 00	–
10	Highland, ...	–	–	–	1,724 75	600 00	–
11	Hillside, ...	–	–	–	1,630 06	600 00	–
12	Hingham (Agricultural and Horticultural), ...	–	–	–	1,756 33	567 65	21 18
13	Hoosac Valley, ...	–	–	10,000 00	4,698 39	600 00	–
14	Housatonic, ...	–	50 00	2,000 00	12,872 32	600 00	–
15	Marshfield (Agricultural and Horticultural), ...	48 70	296 19	2,106 09	6,527 56	600 00	–
16	Martha's Vineyard, ...	–	15 00	–	1,313 87	600 00	50 45
17	Massachusetts Horticultural, .	[2] 6,700 00	–	–	21,741 25	600 00	172 54
18	Massachusetts Society for Promoting Agriculture,[3] . . .	–	–	–	–	–	–
19	Middlesex North, ...	–	–	23,100 00	2,528 96	600 00	–
20	Middlesex South, ...	–	–	7,800 00	1,882 82	600 00	–
21	Nantucket, ...	–	33 85	572 24	1,181 25	600 00	–
22	Oxford, ...	–	–	–	4,391 59	600 00	–
23	Plymouth County, ...	–	–	–	557 58	214 75	76 25
24	Spencer (Farmers' and Mechanics' Association), ...	–	150 00	2,000 00	3,598 85	600 00	–
25	Union (Agricultural and Horticultural), ...	31 50	–	1,300 00	2,679 26	600 00	–
26	Weymouth (Agricultural and Industrial), ...	–	–	2,400 00	4,338 71	595 98	102 63
27	Worcester, ...	–	500 00	–	17,118 65	600 00	1,176 43
28	Worcester East, ...	–	–	–	8,876 78	600 00	24 24
29	Worcester Northwest (Agricultural and Mechanical), . .	–	–	4,050 00	8,810 42	600 00	–
30	Worcester South, ...	166 55	154 25	1,600 00	5,013 43	600 00	–
31	Worcester County West, . . .	–	–	700 00	3,730 71	600 00	–
		$7,098 00	$2,345 14	$89,591 08	$147,605 43	$17,578 38	$1,635 72

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[1] Awarded in 1905.

[2] Awarded in 1906; to be paid in 1907.

FOR THE YEAR ENDING DEC. 31, 1906 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
–	$12 00	$5 00	$700 95	$1,319 26	$645 75	$582 46	$53 50	$37 55	1
$20 00	30 00	448 00	6,123 76	6,675 45	2,133 20	2,676 49	91 62	1,774 14	2
–	–	84 00	379 30	1,095 14	461 31	454 02	110 00	69 81	3
–	47 00	1 50	1,504 61	2,019 47	1,101 20	918 27	–	–	4
–	28 00	82 15	4,037 29	4,599 33	809 36	1,965 63	272 85	1,551 49	5
346 00	–	–	1,720 18	2,686 83	[1] 992 95	641 60	962 81	89 47	6
40 00	–	–	7,029 59	7,664 09	1,561 25	3,310 99	370 78	2,421 07	7
–	20 00	146 02	814 54	1,563 98	600 55	847 18	116 25	–	8
–	100 00	–	5,727 24	5,220 03	1,011 50	1,207 54	106 08	2,894 91	9
–	27 00	–	1,099 75	1,114 11	660 30	397 21	6 60	50 00	10
–	94 00	15 90	920 16	1,478 65	864 26	420 00	–	194 29	11
–	1 00	11 25	1,155 25	896 52	596 65	284 87	–	15 00	12
–	30 00	–	4,068 39	3,475 07	727 25	2,247 82	500 00	–	13
116 26	440 00	–	11,716 06	11,258 32	4,915 50	5,507 10	287 51	548 21	14
–	160 00	2 00	5,765 56	6,223 75	1,789 15	4,067 60	367 00	–	15
–	24 00	11 40	628 02	1,027 41	666 29	260 02	–	101 10	16
10,825 00	796 00	–	9,347 71	25,000 93	[1] 5,690 78	18,385 48	–	924 67	17
–	–	–	–	–	–	–	–	–	18
–	–	–	1,928 96	2,331 97	–	246 50	595 29	1,490 18	19
–	32 00	22 30	1,228 52	1,876 60	976 00	729 67	34 99	135 94	20
–	14 00	5 00	562 25	1,171 24	612 25	558 99	–	–	21
32 96	47 00	4 00	3,707 63	3,352 67	1,423 83	755 87	–	1,172 97	22
–	–	6 00	260 58	494 28	299 75	194 53	–	–	23
–	25 00	–	2,973 85	2,998 85	1,814 65	1,184 20	–	–	24
–	40 00	432 50	1,606 76	2,488 13	1,107 54	675 03	–	705 56	25
–	–	1 50	3,638 60	4,253 57	625 30	150 00	107 00	3,371 27	26
–	85 00	482 23	14,774 99	14,739 71	4,800 90	2,878 85	29 58	7,030 38	27
–	45 00	300 00	7,907 54	7,383 90	1,756 10	5,087 91	–	539 89	28
–	–	–	8,210 42	8,675 31	3,747 00	2,785 81	277 00	1,865 50	29
–	48 00	–	4,365 43	5,145 55	1,943 15	2,424 13	80 00	698 27	30
–	30 00	6 00	3,094 71	4,216 12	2,053 40	2,120 72	42 00	–	31
$11,380 22	$2,175 00	$2,066 75	$116,998 60	$142,446 24	$46,387 12	$63,966 49	$4,410 86	$27,681 67	

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[3] Represented on Board by special enactment, and makes no returns.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$645 75	$645 75	$645 75	–	–	–	$200 25
2	Barnstable County,	2,709 00	2,284 45	2,133 20	$127 00	–	–	645 00
3	Blackstone Valley,	1,056 90	734 85	461 31	135 00	$51 00	$51 00	716 50
4	Deerfield Valley,	1,491 20	1,101 20	1,101 20	–	–	–	901 00
5	Eastern Hampden,	987 00	809 36	809 36	98 00	12 00	12 00	677 00
6	Essex,	2,137 00	[1] 1,209 50	[2] 992 95	–	–	–	1,244 00
7	Franklin County,	1,775 00	1,561 25	1,561 25	–	–	–	1,300 00
8	Hampshire,	1,060 00	600 55	600 55	25 00	–	–	680 00
9	Hampshire, Franklin and Hampden,	1,602 25	1,058 75	1,011 50	50 00	–	–	1,087 00
10	Highland,	783 30	660 30	660 30	–	–	–	465 00
11	Hillside,	935 00	876 16	864 26	3 00	–	–	515 00
12	Hingham (Agricultural and Horticultural),	1,435 05	596 65	596 65	63 75	–	–	–
13	Hoosac Valley,	1,200 00	727 25	727 25	–	–	–	[3] –
14	Housatonic,	5,659 50	4,915 50	4,915 50	–	–	–	1,771 50
15	Marshfield (Agricultural and Horticultural),	2,280 00	1,860 85	1,789 15	89 00	–	–	367 50
16	Martha's Vineyard,	819 25	701 47	666 29	18 00	–	–	442 00
17	Massachusetts Horticultural,	7,018 50	[1] 6,228 75	[2] 5,690 78	359 00	290 00	[2] 191 67	–
18	Massachusetts Society for Promoting Agriculture,[4]	–	–	–	–	–	–	–
19	Middlesex North,[5]	–	–	–	–	–	–	–
20	Middlesex South,	1,813 80	1,068 45	976 00	75 00	13 00	13 00	663 00
21	Nantucket,	1,400 00	612 25	612 25	83 00	9 00	9 00	604 00
22	Oxford,	1,820 25	1,424 00	1,423 83	78 00	40 00	40 00	884 00
23	Plymouth County,	254 25	299 75	299 75	50 00	50 00	50 00	–
24	Spencer (Farmers' and Mechanics' Association),	2,507 25	1,966 75	1,814 65	73 00	48 00	48 00	1,235 00
25	Union (Agricultural and Horticultural),	1,645 90	1,139 03	1,107 54	–	–	–	824 00
26	Weymouth (Agricultural and Industrial),	1,170 15	630 35	525 30	–	–	–	679 00
27	Worcester,	5,092 25	4,800 90	4,800 90	–	–	–	2,415 00
28	Worcester East,	2,500 00	1,761 05	1,756 10	32 00	21 00	21 00	1,756 00
29	Worcester Northwest (Agricultural and Mechanical),	3,355 00	2,714 40	3,747 00	–	–	–	1,600 00
30	Worcester South,	2,350 00	1,940 65	1,943 15	132 00	37 00	31 00	1,011 00
31	Worcester County West,	2,588 75	2,055 00	2,053 40	57 00	24 00	24 00	1,297 00
		$60,092 30	$46,985 17	$46,387 12	$1,547 75	$595 00	$490 67	$23,979 75

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[1] To be paid in 1907.

[2] Awarded in 1905; paid in 1906.

[3] Not reported.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1906.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Farm and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Field and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$200 25	$200 25	–	–	–	$194 30	$194 30	$194 30	–	–	1
427 00	364 50	$175 00	–	–	382 25	279 75	220 25	$10 00	–	2
548 50	329 10	–	–	–	115 40	69 35	41 61	10 00	$3 00	3
633 10	633 10	–	–	–	129 00	66 60	66 60	12 00	10 00	4
513 00	513 00	–	–	–	81 00	130 27	130 27	42 00	25 00	5
506 25	[2] 618 75	–	–	–	500 00	428 75	[2] 387 00	14 00	4 00	6
1,186 00	1,186 00	–	–	–	300 00	241 60	241 60	25 00	21 50	7
327 00	327 00	–	–	–	189 00	101 00	101 00	13 00	2 00	8
801 00	776 25	100 00	–	–	206 50	145 50	137 75	36 00	9 00	9
401 90	401 90	26 75	$12 00	$12 00	54 00	54 95	54 95	5 00	5 00	10
478 29	478 29	45 00	42 00	42 00	62 00	56 55	56 55	7 00	7 00	11
–	–	160 00	22 00	22 00	923 05	437 55	437 55	3 50	2 50	12
309 00	309 00	–	–	–	[3] –	67 75	67 75	[3] –	7 00	13
1,272 50	1,272 50	244 00	204 00	204 00	376 50	284 50	284 50	34 00	25 00	14
305 90	289 10	–	–	–	248 25	226 20	211 95	12 00	6 00	15
288 50	276 82	131 00	64 20	64 20	103 50	64 05	64 05	10 00	11 50	16
–	–	–	–	–	6,659 50	5,938 25	[2] 5,499 11	–	–	17
–	–	–	–	–	–	–	–	–	–	18
–	–	–	–	–	–	–	–	–	–	19
285 50	285 50	–	–	–	319 30	97 70	97 70	–	–	20
265 75	265 75	134 00	34 50	34 50	159 50	47 00	47 00	16 00	–	21
586 25	570 25	38 25	31 25	30 75	78 50	58 00	56 75	12 00	11 00	22
–	–	–	–	–	200 00	196 50	196 50	–	–	23
813 00	813 00	–	–	–	176 50	110 75	110 75	110 00	110 00	24
490 20	476 25	–	–	–	71 25	46 45	46 07	13 50	4 50	25
362 70	361 70	46 00	–	–	210 00	117 70	115 20	–	–	26
1,781 00	1,781 00	–	–	–	464 00	399 50	399 50	29 00	22 00	27
1,190 75	1,190 75	–	–	–	381 25	291 40	291 40	21 00	8 00	28
1,065 50	1,045 50	–	–	–	250 00	178 50	172 50	18 00	3 00	29
787 00	655 00	–	–	–	171 00	127 25	117 00	15 00	12 00	30
895 85	894 25	–	–	–	185 50	129 50	129 50	15 00	6 00	31
$16,721 69	$16,314 51	$1,100 00	$409 95	$409 45	$13,191 05	$10,587 17	$9,976 66	$483 00	$315 00	

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[4] Held no fair and made no report.

[5] Held no fair.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural),	–	$126 45	$126 45	$126 45	$152 75	$152 75
2	Barnstable County,	–	208 25	234 45	210 95	75 75	70 00
3	Blackstone Valley,	$1 80	33 50	16 50	9 90	46 50	27 90
4	Deerfield Valley,	10 00	103 20	91 90	91 90	27 10	27 10
5	Eastern Hampden,	25 00	64 00	53 55	53 55	15 25	15 25
6	Essex,	[3] 4 00	204 00	129 50	[3] 95 20	144 00	[3] 129 00
7	Franklin County,	21 50	150 00	112 15	112 15	–	–
8	Hampshire,	2 00	133 00	33 80	33 80	20 00	15 00
9	Hampshire, Franklin and Hampden,	9 00	58 75	56 00	46 00	47 25	42 50
10	Highland,	5 00	67 80	67 70	67 70	43 75	43 75
11	Hillside,	7 00	93 00	87 19	87 19	56 13	56 13
12	Hingham (Agricultural and Horticultural),	2 50	133 75	79 95	79 95	54 90	54 90
13	Hoosac Valley,	7 00	[1] –	112 55	112 55	27 00	27 00
14	Housatonic,	25 00	374 00	253 50	253 50	108 50	108 50
15	Marshfield (Agricultural and Horticultural),	6 00	198 00	180 75	167 45	42 00	20 50
16	Martha's Vineyard,	11 50	98 25	167 52	167 52	105 70	105 70
17	Massachusetts Horticultural,	–	–	–	–	–	–
18	Massachusetts Society for Promoting Agriculture,[5]	–	–	–	–	–	–
19	Middlesex North,[6]	–	–	–	–	–	–
20	Middlesex South,	–	100 00	45 75	45 75	55 00	55 00
21	Nantucket,	–	60 00	88 75	88 75	57 25	57 25
22	Oxford,	10 00	76 50	44 50	41 25	18 00	18 00
23	Plymouth County,	–	–	53 25	53 25	–	–
24	Spencer (Farmers' and Mechanics' Association),	110 00	70 00	42 25	42 25	27 75	27 75
25	Union (Agricultural and Horticultural),	4 50	144 25	112 68	95 09	127 20	125 63
26	Weymouth (Agricultural and Industrial),	–	165 15	102 60	101 35	47 35	47 05
27	Worcester,	22 00	49 25	37 00	37 00	–	–
28	Worcester East,	8 00	235 80	146 90	134 65	103 00	103 00
29	Worcester Northwest (Agricultural and Mechanical),	3 00	75 00	37 40	34 50	–	–
30	Worcester South,	12 00	86 00	71 15	65 90	106 25	106 25
31	Worcester County West,	6 00	80 25	45 65	45 65	4 00	4 00
		$312 80	$3,242 40	$2,631 34	$2,501 15	$1,512 38	$1,439 91

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[1] Not reported. [2] And gratuities. [3] Awarded in 1905; paid in 1906. [4] Estimated.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1906 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institute Sessions held.	Average Number attending Institutes.	
–	[1] –	[1] –	15	$57 70	105	38	143	3	200	1
$1,267 00	[2] 318	–	10	–	229	199	428	3	75	2
–	70	2	7	–	287	295	582	3	79	3
272 50	250	–	23	86 95	920	256	1,176	5	185	4
500 00	151	–	21	13 00	265	181	446	3	35	5
–	413	–	27	–	1,047	11	1,058	8	81	6
1,150 00	[4] 300	[4] 10	[1] –	–	[4] 1,500	[4] 200	[4] 1,700	4	129	7
359 00	105	3	10	–	660	285	945	3	200	8
475 00	220	–	24	–	605	253	858	6	125	9
75 00	140	–	20	2 00	259	117	376	4	53	10
150 00	425	–	19	–	694	40	734	6	129	11
–	76	51	6	–	377	167	544	4	138	12
695 00	128	3	16	51 45	640	15	655	3	30	13
2,750 00	365	–	14	–	1,466	57	1,523	3	85	14
1,080 00	87	233	38	60 20	520	294	814	5	75	15
–	[1] –	[1] –	5	–	84	85	169	3	33	16
–	214	85	93	289 84	738	113	851	10	150	17
–	–	–	–	–	–	–	–	–	–	18
–	–	–	–	–	1,112	445	1,557	11	275	19
571 50	73	15	12	–	326	188	514	3	43	20
110 00	123	34	1	–	372	225	597	2	11	21
635 00	[1] –	[1] –	12	–	352	277	629	3	90	22
–	[2] 106	–	8	–	682	528	1,210	3	36	23
815 00	113	12	19	–	470	411	881	2	95	24
360 00	134	51	20	3 25	649	823	1,472	3	225	25
–	[1] –	[1] –	20	9 50	476	14	490	3	78	26
2,135 00	178	5	40	613 00	1,643	166	1,809	3	138	27
870 00	311	95	37	106 25	465	294	759	6	104	28
1,430 00	177	–	39	11 50	652	380	1,032	5	96	29
800 00	115	52	26	31 00	680	669	1,349	5	71	30
950 00	125	62	30	50 00	378	71	449	3	85	31
$17,450 00	4,717	713	606	$1,385 64	18,653	7,097	25,750	128	[7] 127	

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[5] Held no fair and made no report. [6] Held no fair. [7] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN MASSACHUSETTS.

APRIL, 1907.

STATE BOARD OF AGRICULTURE, 1907.

Members ex Officio.

HIS EXCELLENCY CURTIS GUILD, JR.
HIS HONOR EBEN S. DRAPER.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, M.A., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, PH.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
F. WM. RANE, B. AGR. M.S., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
WILLIAM R. SESSIONS of Springfield,	1908
FRANCIS H. APPLETON of Peabody,	1909
WARREN C. JEWETT of Worcester,	1910

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1909
Barnstable County,	JOHN BURSLEY of West Barnstable,	1910
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1909
Deerfield Valley,	E. P. WILLIAMS of Ashfield (P. O. Buckland),	1908
Eastern Hampden,	O. E. BRADWAY of Monson,	1909
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1908
Franklin County,	FRANK GERRETT of Greenfield,	1910
Hampshire,	HENRY E. PAIGE of Amherst,	1910
Hampshire, Franklin and Hampden,	WM. A. BAILEY of Northampton,	1909
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1908
Hillside,	RALPH M. PORTER of Cummington,	1908
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1909
Hoosac Valley,	A. M. STEVENS of Williamstown,	1909
Housatonic,	EDWIN L. BOARDMAN of Sheffield,	1909
Marshfield (Agr'l and Hort'l),	H. A. OAKMAN of North Marshfield,	1909
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1910
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1909
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1909
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1908
Nantucket,	H. G. WORTH of Nantucket,	1909
Oxford,	WALTER A. LOVETT of Oxford,	1910
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1908
Spencer (Far's and Mech's Assoc'n),	NOAH SAGENDORPH of Spencer,	1910
Union (Agr'l and Hort'l),	GEORGE O. MILLARD of Blandford,	1910
Weymouth (Agr'l and Ind'l),	QUINCY L. REED[1] of South Weymouth,	1909
Worcester,	WALTER D. ROSS of Worcester,	1908
Worcester East,	W. A. KILBOURN of South Lancaster,	1909
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1910
Worcester South,	C. D. RICHARDSON of West Brookfield,	1910
Worcester County West,	J. HARDING ALLEN of Barre,	1908

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[1] Died April 8, 1907.

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . .	His Excellency CURTIS GUILD, Jr., *ex officio.*
1st Vice-President,	WILLIAM R. SESSIONS of Springfield.
2d Vice-President, .	AUGUSTUS PRATT of North Middleborough.
Secretary, . .	J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. Kilbourn of South Lancaster.
John Bursley of West Barnstable.
Wm. H. Spooner of Boston.
Francis H. Appleton of Peabody.
Augustus Pratt of North Middleborough.
C. D. Richardson of West Brookfield.
Edmund Hersey of Hingham.
Henry E. Paige of Amherst.

Committee on Agricultural Societies.

Messrs. W. A. Kilbourn of South Lancaster.
Q. L. Reed of South Weymouth.
O. E. Bradway of Monson.
J. Harding Allen of Barre.
Albert Ellsworth of Athol.

Committee on Domestic Animals and Sanitation.

Messrs. Henry E. Paige of Amherst.
A. M. Stevens of Williamstown.
E. P. Williams of Ashfield.
W. D. Ross of Worcester.
Walter A. Lovett of Oxford.

Committee on Gypsy Moth, Insects and Birds.

Messrs. Augustus Pratt of North Middleborough.
J. M. Danforth of Lynnfield.
W. C. Jewett of Worcester.
Walter D. Ross of Worcester.
Noah Sagendorph of Spencer.

Committee on Dairy Bureau and Agricultural Products.

Messrs. C. D. Richardson of West Brookfield.
J. M. Danforth of Lynnfield.
Henry E. Paige of Amherst.
S. B. Taft of Uxbridge.
George O. Millard of Blandford.

Committee on Massachusetts Agricultural College.

Messrs. John Bursley of West Barnstable.
W. C. Jewett of Worcester.
Isaac Damon of Wayland.
E. L. Boardman of Sheffield.
Frank Gerrett of Greenfield.

Committee on Experiments and Station Work.

Messrs. Wm. H. Spooner of Boston.
N. I. Bowditch of Framingham.
Ralph M. Porter of Cummington.
E. P. Williams of Ashfield.
H. A. Oakman of Marshfield.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Peabody.
H. G. Worth of Nantucket.
J. J. Mason of Amesbury.
Henry S. Pease of Middlefield.
F. Wm. Rane of Boston.

Committee on Institutes and Public Meetings.

Messrs. Edmund Hersey of Hingham.
Wm. R. Sessions of Springfield.
Wm. A. Bailey of Northampton.
Kenyon L. Butterfield of Amherst.
J. F. Adams of West Tisbury.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. C. D. Richardson of West Brookfield, 1908; Henry E. Paige of Amherst, 1909; J. M. Danforth of Lynnfield, 1907.

Executive Officer,	J. L. Ellsworth.
General Agent,	P. M. Harwood of Barre.

Office, Room 136, State House.

STATE NURSERY INSPECTOR.

Henry T. Fernald, Ph.D., of Amherst.

SPECIALISTS.

By Election of the Board.

Chemist,	Dr. C. A. Goessmann,	Amherst.
Entomologist,	Prof. C. H. Fernald,	Amherst.
Botanist,	Dr. Geo. E. Stone,	Amherst.
Pomologist,	Prof. F. A. Waugh,	Amherst.
Veterinarian,	Prof. James B. Paige,	Amherst.
Engineer,	Wm. Wheeler,	Concord.
Ornithologist,	E. H. Forbush,	Wareham.

By Appointment of the Secretary.

Librarian, F. H. Fowler, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

BOARD OF TRUSTEES.

	Term expires
NATHANIEL I. BOWDITCH of Framingham,	1908
WILLIAM WHEELER of Concord,	1908
ARTHUR G. POLLARD of Lowell,	1909
CHARLES A. GLEASON of Springfield,	1909
FRANK GERRETT of Greenfield,	1910
SAMUEL C. DAMON of Lancaster,	1910
PARLEY A. RUSSELL of Great Barrington,	1911
CHARLES W. PRESTON of Danvers,	1911
CARROLL D. WRIGHT of Worcester,	1912
M. FAYETTE DICKINSON of Boston,	1912
WILLIAM H. BOWKER of Boston,	1913
GEORGE H. ELLIS of Newton,	1913
J. HOWE DEMOND of Northampton,	1914
ELMER D. HOWE of Marlborough,	1914

MEMBERS EX OFFICIO.

His Excellency Governor CURTIS GUILD, Jr.,
President of the Corporation.

KENYON L. BUTTERFIELD, M.A.,	*President of the College.*
GEORGE H. MARTIN,	*Secretary of the Board of Education.*
J. LEWIS ELLSWORTH,	*Secretary of the Board of Agriculture.*

OFFICERS ELECTED BY THE BOARD OF TRUSTEES.

CHARLES A. GLEASON of Springfield,	*Vice-President of the Corporation.*
J. LEWIS ELLSWORTH of Worcester,	*Secretary.*
Prof. GEORGE F. MILLS of Amherst,	*Treasurer.*
CHARLES A. GLEASON of Springfield,	*Auditor.*
KENYON L. BUTTERFIELD, M.A., of Amherst,	*President of the College.*

BOARD OF OVERSEERS.

The State Board of Agriculture.

EXAMINING COMMITTEE OF THE BOARD OF AGRICULTURE.

Messrs. BURSLEY, JEWETT, DAMON, BOARDMAN and GERRETT.

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.[1]

WM. P. BROOKS, Ph.D.,	*Agriculturist and Director.*
F. A. WAUGH, B.Sc.,	*Horticulturist.*
CHARLES H. FERNALD, Ph.D.,	*Entomologist.*
HENRY T. FERNALD, Ph.D.,	*Assistant Entomologist.*
CHAS. A. GOESSMANN, Ph.D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, Ph.D.,	*Chemist* (Foods and Feeding).
GEORGE E. STONE, Ph.D.,	*Botanist.*
J. E. OSTRANDER, C.E.,	*Meteorologist.*

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[1] See Acts of 1907, chapter 66.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,[1] . .	A. W. Bartlett, Salisbury.	M. H. Sands, Amesbury.	John J. Mason, Amesbury.
Barnstable County, . . .	Dr. Gorham Bacon, Yarmouth.	M. N. Harris, Barnstable.	Henry C. Davis, Cummaquid.
Blackstone Valley, . . .	W. A. L. Bazeley, Boston.	Dr. M. R. Sharpe, Uxbridge.	Dr. M. R. Sharpe, Uxbridge.
Deerfield Valley, ...	D. T. Barnard, Shelburne.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden, . . .	O. E. Bradway, Monson.	L. E. Chandler, Palmer.	W. L. Shaw, Palmer.
Essex, ...	Fred'k A. Russell, Methuen.	J. M. Danforth, Lynnfield.	W. S. Nichols, Salem.
Franklin County, ...	Chas. P. Aldrich, Greenfield.	Henry J. Field, Greenfield.	Frank H. Snow, Greenfield.
Hampshire, ...	Dr. Henry E. Paige, Amherst.	H. A. Parsons, Amherst.	H. A. Parsons, Amherst.
Hampshire, Franklin and Hampden.	Frank P. Newkirk, Easthampton.	C. A. Montgomery, Northampton.	C. A. Montgomery, Northampton.
Highland, ...	Henry E. Stanton, Huntington.	J. T. Bryan, Middlefield.	Geo. S. Bell, Middlefield.
Hillside, ...	H. A. Ford, Windsor.	C. F. Burr, Ringville.	D. E. Lyman, Cummington.
Hingham,[1]	Geo. E. Kimball, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley, ...	Dr. F. D. Stafford, North Adams.	Gilbert Maxwell, North Adams.	M. R. Ford, North Adams.
Housatonic, ...	C. H. Warner, Sheffield.	Fred J. Fuller, Great Barrington.	Geo. L. Taylor, Great Barrington.
Marshfield,[1]	Thomas W. Lawson, Boston.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard, . . .	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural, .	Gen. S. M. Weld, Dedham.	Wm. P. Rich, Boston.	C. E. Richardson, Brookline.
Massachusetts Society for Promoting Agriculture.	C. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex South, ...	Chas. F. Parsons, South Framingham.	Geo. C. Blades, South Framingham.	George E. Fay, Framingham.
Nantucket, ...	H. G. Worth, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford, ...	L. F. Kilty, Oxford.	J. E. Darling, Oxford.	J. E. Darling, Oxford.
Plymouth County, ...	Augustus Pratt, North Middleborough.	J. Herbert Leonard, Bridgewater.	J. Herbert Leonard, Bridgewater.

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[1] And horticultural.

AGRICULTURAL SOCIETIES, ETC. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Spencer Farmers' and Mechanics' Association.	Walter C. Bemis, Spencer.	Geo. H. Ramer, Spencer.	Geo. H. Ramer, Spencer.
Union,[1]	H. K. Herrick, Blandford.	E. W. Boise, Blandford.	Geo. O. Millard, Blandford.
Weymouth (Ag'l and Ind.), .	Josiah B. Reed, South Weymouth.	A. Francis Barnes, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester, ...	Ledyard Bill, Paxton.	E. S. Knowles, Worcester.	L. F. Herrick, Worcester.
Worcester East, ...	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical).	Dr. James Oliver, Athol Centre.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South, ...	Geo. L. Clemence, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West, . .	Joel L. Powers, Hardwick.	D. H. Rice, Barre.	M. H. Bacon, Barre.

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[1] And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann, ...	Gloucester, ...	Bennett Griffith, Gloucester.	Wm. D. Lufkin, Gloucester.
Haverhill, ...	Haverhill, ...	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County, ...	Springfield, ...	Adolph Mielliz, Springfield.	William F. Gale, Springfield.
Houghton, ...	Lynn, ...	J. John Hooper, Lynn.	I. W. Horne, Lynn.
Lenox, ...	Lenox, ...	F. Heeremans, Lenox.	Geo. H. Instone, Lenox.
Massachusetts, ...	The State, ...	Arthur F. Estabrook, Boston.	Wm. P. Rich, Boston.
North Shore, ...	Manchester, ...	James McGregor, Manchester.	James Salter, Manchester.
Springfield Amateur, ...	Springfield, ...	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County, ...	Worcester, ...	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

FARMERS' AND MECHANICS' ASSOCIATIONS.

Bolton,	Bolton,	Legrand F. Brigham, Bolton.	William M. Brigham, Bolton.
Needham,	Needham,	Samuel Watts, Natick.	Richmond Favor, Natick.
Oakham,	Oakham,	Wm. Parkman, Oakham.	John P. Day, Jr., Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	C. F. Giles, Westminster.	A. L. Stone, Westminster.

FARMERS' AND MECHANICS' CLUBS.

Ashburnham,	Ashburnham,	E. J. Forristall, South Ashburnham.	W. E. Jefts, Ashburnham.
Belchertown,	Belchertown,	Harry Ward, Belchertown.	Almon Pratt, Belchertown.
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	Levi H. Howe, Holden.	Mrs. H. J. Jones, Holden.
Pepperell,	Pepperell,	H. W. Hutchinson, Pepperell.	Chas. F. Spaulding, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Boxborough,	Boxborough,	R. Y. Nelson, Boxborough.	G. W. Burroughs, Boxborough.
Buckland,	Buckland,	W. S. Williams, Buckland.	W. D. Forbes, Shelburne Falls.
Chamberlain District,	Worcester,	Pliny Moore, Worcester.	S. A. Burgess, Worcester.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	Edward S. Cook, Franklin.	Fred M. Thayer, Franklin.
Halifax,	Halifax,	Jas. T. Thomas, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	D. C. Wetherell, New Braintree.	Chas. S. Lane, New Braintree.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Wm. H. Gladding, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	L. J. Kendall, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Appleton P. Williams, Upton.	Geo. Z. Williams, Upton.
West Brookfield,	West Brookfield,	Fred G. Smith, West Brookfield.	Sumner H. Reed, West Brookfield.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D. 2, Ludlow.

POULTRY ASSOCIATIONS.

Amesbury Poultry and Pet Stock Association.	Amesbury,	W. E. Tibbetts, Amesbury.	M. H. Sands, Amesbury.
Athol Poultry and Pet Stock Association,	Athol,	- -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	E. A. Morrow, Salem.	Daniel P. Foster, North Beverly.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Fitchburg Poultry and Pet Stock Association.	Fitchburg,	Henry Shaw, Leominster.	L. D. Mudgett, Leominster.
Greenfield Score Card Poultry Club,	Greenfield,	H. M. Woodward, Greenfield.	F. L. Gaines, Greenfield.
Lawrence Poultry and Pet Stock Association.	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Milford Poultry Association,	Milford,	H. W. Reed, Caryville.	W. H. Pyne, Milford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
North Adams Poultry Association,	North Adams,	Dr. D. D. Stafford, North Adams.	C. M. Ottman, North Adams.
Northampton Poultry Association,	Northampton,	C. E. Hodgkins, Northampton.	C. L. Gallup, Northampton.
Plymouth Poultry Association,	Plymouth,	T. Allen Baguell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association.	Springfield,	E. C. Powell, Lougmeadow.	E. S. Evans, Springfield.
West Brookfield Poultry Association,	West Brookfield,	R. H. Buflington, West Brookfield.	E. L. Richardson, West Brookfield.

MISCELLANEOUS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Agricultural Society of Harvard University,	Cambridge,	Geo. L. Wilson, Cambridge.	Stewart W. Michie, Jamaica Plain.
Bay State Agricultural Society,	The State,	C. Minot Weld, Boston.	N. I. Bowditch, Framingham.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. B. Shurtleff, Jr., Revere.
Brockton Agricultural Society,	Brockton,	Hon. H. W. Robinson, Brockton.	Baalis Sanford, Brockton.
Cranberry Growers' Association,	Cape Cod District,	George R. Briggs, Bournedale.	Wm. M. Marsh, Wareham.
Franklin Harvest Club,	Connecticut Valley,	F. F. Burt, Easthampton.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	Henry M. Taylor, Easthampton.
Massachusetts Cattle Owners' Association,	The State,	B. W. Potter, Worcester.	J. L. Harrington, Lunenburg.
Massachusetts Creamery Association,	The State,	W. H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Boston.
Massachusetts Fruit Growers' Association,	The State,	C. A. Whitney, Upton.	S. T. Maynard, Northborough.
Stockbridge Club,	Amherst,	Jasper F. Eastman, Amherst.	John Daniel, Amherst.
Wakefield-Reading Fair Company,	Wakefield,	George A. Shackford, Reading.	B. F. Calley, Jr., Wakefield.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Worcester County Harvest Club,	Worcester,	B. W. Potter, Worcester.	Mrs. W. C. Jewett, Worcester.
Worcester County Bee-keepers' Association,	Worcester,	Burton N. Gates, Worcester.	C. R. Russell, Worcester.
Worcester North Agricultural Society,	Fitchburg,	H. O. Mead, Lunenburg.	W. H. Laws, Ashburnham.

MASSACHUSETTS PATRONS OF HUSBANDRY.

OFFICERS OF THE STATE GRANGE, 1907.

Master,	Carlton D. Richardson of West Brookfield.
Overseer,	John E. Gifford of Brockton.
Lecturer,	Charles M. Gardner of Westfield.
Steward,	C. C. Colby of Hubbardston.
Assistant Steward,	C. O. Littlefield of Sherborn.
Chaplain,	Rev. H. A. Wheelock of Marlborough.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	Wm. P. Greenwood of Milford.
Ceres,	Mrs. Ida Coleman of Richmond.
Pomona,	Mrs. Nellie S. Stevens of Wellesley.
Flora,	Miss Ida I. Beals of Winchendon.
Lady Assistant Steward,	Mrs. S. Mabel Thompson of Hopkinton.

EXECUTIVE COMMITTEE.

George L. Clemence,	Southbridge.
George S. Ladd,	Sturbridge.
C. A. Dennen,	Pepperell.

GENERAL DEPUTIES.

James Draper,	Worcester.
N. B. Douglas,	Sherborn.
E. D. Howe,	Marlborough.
W. C. Jewett,	Worcester.
G. S. Ladd,	Sturbridge.
A. C. Stoddard,	North Brookfield.
Herbert Sabin,	Amherst.

POMONA DEPUTIES.

Hon. M. A. Morse,	Belchertown.
W. E. Patrick,	Warren.
Mrs. S. Ella Southland,	Athol Centre.

SUBORDINATE GRANGE DEPUTIES.

C. H. Shaylor,	Lee.
Henry N. Jenks,	Cheshire.
W. A. Harlow,	Cummington.
F. L. Warfield,	Buckland.
E. B. Hale,	Bernardston.
C. R. Damon,	Williamsburg.
L. R. Smith,	Hadley.
E. E. Chapman,	Ludlow.
Geo. W. Sherman,	Brimfield.
C. A. Stimson,	Royalston.
W. H. Sawyer,	Winchendon.
T. E. Flarity,	Townsend.
E. H. Gilbert,	North Easton.

SUBORDINATE GRANGE DEPUTIES — *Con.*

Moses Gaskill,	Mendon.
L. H. Cudworth,	Oxford.
E. F. Richardson,	Millis.
Elbridge Noyes,	Newbury.
Geo. E. Crosby,	Tewksbury.
John Bursley,	West Barnstable.
G. M. Wason,	Haverhill.

SPECIAL DEPUTIES.

John E. Gifford,	Brockton.
Wm. N. Howard,	South Easton.
G. C. Sevey,	Springfield.
W. T. Herrick,	Westborough.

COMMITTEE ON WOMAN'S WORK.

Mrs. D. P. Bardwell,	Bardwell's Ferry.
Mrs. Geo. S. Ladd,	Sturbridge.
Mrs. H. E. Cummings,	North Brookfield.
Mrs. T. E. Flarity,	Townsend.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	Abel F. Stevens, Wellesley.	J. Herbert Baker, Medfield.	Mrs. Alice A. Duprez, Franklin.
Essex County, No. 2,	Samuel Emerson, Methuen.	Mrs. Elizabeth M. Newell, West Newbury.	Miss Matilda B. Lund, West Boxford.
Middlesex-Worcester, No. 3,	Frank N. Boutelle, North Leominster.	Mrs. Georgia Mason, Ayer.	Mrs. Minnie L. F. Knight, Townsend Harbor.
Franklin and Worcester, No. 4,	Mrs. S. Ella Southland, Athol.	Mrs. Mary C. Litchfield, Athol.	A. J. Hastings, Orange, R. F. D., No. 2.
Worcester West, No. 5,	Harry E. Murdock, Hubbardston.	Rev. P. S. Crowell, Petersham.	Mrs. Eva C. Moore, Hubbardston.
Berkshire County, No. 6,	H. N. Jenks, Adams, R. F. D.	F. V. Petit, Housatonic, R. F. D.	R. P. Coleman, Pittsfield, R. F. D.
Worcester Central, No. 7,	W. H. Wellington, Upton.	Mrs. C. H. Freeman, Worcester.	Mrs. Adelle Grout, Worcester.
Hampshire County, No. 8,	John McQueston, South Hadley, R. F. D.	Mrs. Fannie Clary, Williamsburg.	Mrs. M. A. Ward, South Deerfield, R. F. D.
Worcester Southwest, No. 9,	Mrs. Mary O. Lakin, Brookfield, R. F. D.	Harry C. Shepard, Globe Village.	Mrs. Mary Q. Ainsworth, E. Brookfield.
Worcester and Norfolk, No. 10,	Moses U. Gaskill, Mendon.	Frank H. Wood, Mendon.	A. W. Gaskill, Mendon.
Borough, No. 11,	John K. Mills, Northborough, R. F. D.	Mrs. S. Mabel Thompson, Westborough.	Mrs. Maria A. Gilmore, Westborough, R. F. D.
Springfield, No. 12,	Chas. B. Bennett, Ludlow.	Mrs. A. C. Barker, Springfield.	Mrs. C. L. Hayward, Agawam.
Old Colony, No. 13,	Joseph W. Baldwin, North Easton.	Mrs. Louisa Carpenter, Attleborough.	Mrs. Alida N. Stevens, South Braintree.
Worcester East, No. 14,	Mrs. Ella D. Rice, Leominster.	Joseph H. Kilbourn, Pratt's Junction.	Mrs. Ida. A. Cunningham, Lancaster.
Quaboag, No. 15,	H. N. Shepard, Warren.	Mrs. Ida L. Warren, Leicester.	Arthur Bliss, North Brookfield.
Middlesex North, No. 16,	Walter E. Morris, Billerica.	Arthur H. Coburn, Dracut.	Mrs. Mabel H. Peavey, Lowell, R. F. D.
Deerfield Valley, No. 17,	Clinton A. Hawkes, Charlemont.	Mrs. D. P. Bardwell, Bardwell's Ferry.	Miss Mary C. Burrington, Heath.
Western Hampden, No. 18,	Nelson J. Trench, Southwick.	Chas. M. Gardner, Westfield.	Annette Sackett, Westfield.
Connecticut Valley, No. 19,	Haven A. Mowry, Greenfield.	Miss Martha Sprague, Greenfield.	Mrs. Nellie Hale, Bernardston.
Hillside, No. 20,	C. A. Williams, Plainfield.	Perley A. Skelton, Worthington.	Mrs. A. R. Tirrell, Plainfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	John W. Bragg, Greenfield.	Mrs. Matthew Barber, Greenfield.	Haven A. Mowry, Greenfield.
Deerfield, No. 2,	Caleb Allen, Deerfield.	Mrs. Edwin A. Hawks, Deerfield.	P. G. Davis, Deerfield.
Northfield, No. 3,	Fred W. Wilber, Northfield.	Mrs. M. T. Moore, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	Daniel W. Mason, Ayer.	Mrs. Mary E. Boynton, Groton.	Mrs. Ella P. Woolley, Groton.
Conway, No. 8,	Joseph H. Antes, Conway.	Mrs. L. C. M. Hopkins, Conway.	Mrs. J. H. Antes, Conway.
Barre, No. 9,	Edwin C. Hunt, Barre.	Mrs. L. B. Wood, Barre.	J. M. Washburn, Barre.
"Hope" of Hadley, No. 15,	A. L. Carpenter, Hadley.	Stella Bell, Hadley.	Mrs. Henry Edson Smith, Hadley.
Amherst, No. 16,	Prof. F. A. Waugh, Amherst.	Mrs. E. E. Perry, Amherst.	Mrs. T. E. Brigham, Amherst.
Cheshire, No. 17,	Jabez C. Jenks, Adams, R. F. D.	Mrs. Lena M. Bennett, Cheshire.	Mrs. Maude L. Purdy, Cheshire.
Hinsdale, No. 19,	Fred N. Warren, Hinsdale.	Mrs. Fred Wilson, Hinsdale.	W. E. Morgan, Hinsdale.
Westfield, No. 20,	A. L. Sanborn, Westfield.	Mrs. C. M. Gardner, Westfield.	Annette Sackett, Westfield.
Lanesborough, No. 21,	Arthur E. Simmons, Lanesborough.	Miss Eunice Tollitson, Lanesborough.	Miss Anna S. Owen, Lanesborough.
Worcester, No. 22,	Willis E. Cary, Worcester.	Miss Mary E. Atherton, Worcester.	Mrs. Chas. W. Moore, Worcester.
Dalton, No. 23,	James Bardin, Dalton.	Mrs. J. J. Glynn, Dalton.	Frank N. Groesbeck, Dalton.
Blandford, No. 24,	Miss Bertha M. Richards, Blandford, R. F. D.	Warren J. Peebles, Blandford, R. F. D.	Geo. L. Hosea, Blandford, R. F. D.
New Lenox, No. 26,	Harry Sears, New Lenox.	Mrs. H. H. Dewey, New Lenox.	H H. Dewey, New Lenox.
Easthampton, No. 27,	Walter Bartlett, Easthampton.	Mrs. Geo. McEvoy, Easthampton.	Miss Mary Knox, Easthampton.
Richmond, No. 32,	Frank Barnes, Richmond, R. F. D.	Miss Anna Medlyn, Richmond.	Robert P. Coleman, Pittsfield, R. F. D.
Adams, No. 34,	Mrs. L. E. Dudley, Adams.	Mrs. C. A. Daniels, Adams.	Miss Ora Dudley, Adams.
Leverett, No. 37,	Chas. E. Smith, Leverett.	Mrs. Herbert Field, Leverett.	Mrs. Mary E. Vaughan, Leverett.
Granville, No. 40,	H. B. Dickinson, Granville.	Mrs. May Hartley, Granville.	Mrs. I. L. Gibbons, Granville.
Montgomery, No. 45,	Mrs. A. J. Hall, Montgomery.	Mrs. I. Florence Mache, Russell.	Miss Florence Moore, Montgomery.
Southwick, No. 46,	Walter P. Griffin, Southwick.	Mrs. C. G. Stone, Southwick.	Mrs. W. P. Griffin, Southwick.
Becket, No. 47,	C. M. Capen, Becket.	H. R. Molineux, Becket.	R. A. Spencer, Becket.
"Highland" of Huntington, No. 48.	Edwin D. Cady, Huntington.	Mrs. Belle S. Wilbur, Huntington.	Edwin F. Goodwin, Huntington.

"Granite" of South Worthington, No. 49.	Irwin C. Bradley, South Worthington.	Mrs. Hattie Hescock, So. Worthington.	Mrs. Mabel C. Smith, Ringville.
Sterling, No. 53,	Joseph R. Graham, Pratts Junction.	J. H. Kilbourn, Pratt's Junction.	Louis A. Stuart, Pratt's Junction.
Springfield, No. 54,	Nelson R. Hosley, Springfield.	Mrs. Wm. E. Nettleton, Springfield.	Mrs. Belle Barney, Springfield.
Cummington, No. 56,	Milton S. Howes, Swift River.	Robert A. Daley, Cummington.	C. A. Stevens, Cummington.
Auburn, No. 60,	Chas. E. Stone, Worcester.	Mrs. C. F. Freeman, Auburn.	Geo. M. Duvall, Auburn.
"Union" of Belchertown, No. 64,	A. E. Pease, Belchertown.	Miss Rose E. Olds, Belchertown.	Mrs. Effie J. Freeman, Belchertown.
Brimfield, No. 65,	O. E. Parker, Brimfield.	C. King, Brimfield.	Mrs. Geo. E. Hitchcock, Brimfield.
Charlemont, No. 66,	C. T. Haskins, Charlemont.	Dexter G. Davenport, Charlemont.	Anna Porter, Charlemont.
Hardwick, No. 67,	J. N. Hillman, Hardwick.	Mrs. J. S. Hillman, Hardwick.	F. M. Bliss, Hardwick.
Shelburne, No. 68,	D. P. Bardwell, Bardwell's.	Mrs. D. P. Bardwell, Bardwell's.	Mrs. W. J. Purrington, Shelburne.
Ashfield, No. 69,	H. L. Clark, Ashfield.	Mrs. H. L. Clark, Ashfield.	Mrs. Maud C. Dyer, Ashfield.
Phillipston, No. 70,	Walter White, Phillipston.	Mrs. Mary R. Chaffin, Phillipston.	Mrs. Cora A. Dunton, Athol, R. F. D.
Leyden, No. 71,	E. P. Howes, Leyden.	Mrs. Laura K. Wright, Leyden.	Mrs. Gratia Campbell, Greenfield.
"Prescott" of Pepperell, No. 73,	Fred O. Parker, Pepperell.	Miss Lucy Blood, Pepperell.	Miss S. Luella Parker, East Pepperell.
Colrain, No. 76,	Geo. E. Clark, Lyonsville.	Mrs. Allen Smith, Griswoldville.	Miss Bessie Kemp, Colrain.
Windsor, No. 77,	Chas. H. Hathaway, East Windsor.	Jesse A. Miner, Cummington.	Mrs. Belle D. Miner, Cummington.
Holden, No. 78,	Chas. S. Graham, Holden, R. F. D.	Mrs. T. W. Howe, Holden, R. F. D.	Mrs. C. M. Stanhope, Holden, R. F. D.
Spencer, No. 79,	Elmer E. Bacon, Spencer.	J. R. Kane, Spencer.	J. W. Bigelow, Spencer.
Bernardston, No. 81,	Frank W. Putnam, Bernardston.	Mrs. R. H. Cushman, Bernardston.	H. T. Lazelle, Bernardston.
"Manhan" of Southampton, No. 82.	Chas. S. Hooker, Holyoke.	Miss Julia E. Norris, Southampton.	Mrs. C. P. Gridley, Southampton.
Warwick, No. 85,	Geo. A. Witherell, Warwick.	Henry C. Iram, Warwick.	A. J. Hastings, Orange, R. F. D.
North Orange, No. 86,	Wm. A. Taylor, North Orange.	Mrs. Hattie M. Baker, North Orange.	A. C. White, North Orange.
Buckland, No. 87,	H. B. Wells, Shelburne Falls.	Mr. Inez King, Buckland.	Mrs. Mary Bradford, Buckland.
Lee, No. 88,	C. G. Hinckley, Lee.	Mrs. Jas. E. Seacord, Lee.	Mrs. W. M. Shaylor, Lee.
Worthington, No. 90,	Chas. F. Bates, Worthington.	Mrs. Nellie Bates, Worthington.	Miss Bessie E. Trow, Worthington.
Charlton, No. 92,	E. M. Bowers, Charlton Depot.	Miss Minnie Thompson, Southbridge.	R. E. Bowers, Charlton Depot.
Grafton, No. 93,	Silas Goddard, Grafton.	Mrs. M. Lizzie Johnson, North Grafton.	Mrs. Eva M. Sibley, Grafton.
Petersham, No. 95,	E. O. Coolidge, Petersham.	Mrs. Mabel A. Coolidge, Petersham.	Chas. W. Snow, Petersham.
Savoy, No. 99,	B. H. Hollis, West Cummington.	Mrs. Ada Fuller, Savoy.	Mrs. Anna Briggs, Savoy.
Shrewsbury, No. 101,	Chas. W. Watts, Shrewsbury.	Mrs. Lewis E. Gates, Shrewsbury.	Mrs. Emily A. Carey, Shrewsbury.
Stow, No. 103,	Chas. A. Hearsey, Gleasondale.	Mrs. Carrie L. Smith, Stow.	Mrs. N. S. Lewis, West Acton.

Massachusetts Patrons of Husbandry — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Garfield" of No. Dana, No. 104,	Mrs. Abbie Whitney, North Dana.	Mrs. Emma Kendall, North Dana.	Mrs. Nettie F. Wood, North Dana.
Marlborough, No. 105, . . .	Joseph Walker, Marlborough.	F. Howard Brown, Marlborough.	Mrs. E. D. Howe, Marlborough.
Millbury, No. 107, ...	Gustav A. Neudek, Millbury.	Calvin W. Brackett, Millbury.	Miss Susan A. Hayward, Millbury.
Hudson, No. 108, ...	Percy R. Coldwell, Hudson.	D. C. Staples, Hudson.	Mary E. Lawrence, Hudson.
Sutton, No. 109, ...	R. H. Richardson, Sutton, R. F. D.	Frank H. Benedict, Sutton, R. F. D.	Miss Sarah M. Mills, Sutton, R. F. D.
Sherborn, No. 110, ...	Oscar Howe, South Sherborn.	Elijah Barber, Sherborn.	Miss Annie H. Daniels, South Sherborn.
Boylston, No. 111, ...	Robert B. Andrews, Boylston Center.	Miss Henrietta M. Andrews, Boylston.	Mrs. Angelina B. Brousseau, Boylston Center.
East Medway, No. 112, . . .	Fred H. Holland, Jr., Millis.	Mrs. Fred H. Holland, Jr., Millis.	Howard A. Payson, Millis.
Framingham, No. 113, . . .	David E. Stone, Framingham.	Mrs. A. H. Wood, Framingham.	Geo. E. Fay, South Framingham, R. F. D.
Medfield, No. 114, ...	George R. Steere, Medfield.	Turner R Bailey, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115, ...	Albert W. Littlefield, Holliston.	Miss Mary E. Cutler, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116, . . .	Wm. T. Herrick, Westborough, R. F. D.	Mrs. Maria A. Gilmore, Westborough, R. F. D.	Mrs. Julia H. Rogers, Westborough, R. F. D.
Dover, No. 117, ...	Granville Perkins, Needham, R. F. D.	Mrs. Inez M. Packard, Needham, R. F. D.	Mrs. E. A. Wotton, Dover.
Southborough, No. 118, . . .	E. C. Wells, Southborough.	Mrs. Wm. Duncan, Southborough.	Mrs. E. C. Wells, Southborough.
Northborough, No. 119, . . .	John W. Allen, Northborough.	Mrs. Blanche E. Kimball, Northborough.	Miss Emma M. Cutler, Northborough.
Lancaster, No. 120, ...	J. Fred Brown, South Lancaster.	Andrew J. Kennedy, Lancaster.	Mrs. Harriet A. Sartelle, Lancaster.
Sudbury, No. 121, ...	Roy A. Whitney, Maynard, R. F. D.	Thomas F. O'Neill, Maynard, R. F. D.	Miss Angie M. Bent, Sudbury.
Templeton, No. 122, ...	Eugene C. Hursey, Templeton.	John A. Braithwaite, Templeton.	Mrs. R. S. Titterton, Templeton.
Oxford, No. 123, ...	Robert B. Taft, Oxford.	Mrs. Maria C. Mann, Oxford.	L. H. Cudworth, Oxford.
Ashland, No. 124, ...	Henry C. Burnham, Ashland.	Mrs. W. A. Stone, Ashland, R. F. D.	Mrs. C. E. Burr, Box 21, Ashland.
Upton, No. 125, ...	Sylvester L. Madden, Milford.	Miss Myrtice S. King, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126, . . .	J. Frank Flagg, Hubbardston.	Mrs. Chas. H. Smith, Hubbardston.	E. A. Young, Hubbardston.
Amesbury, No. 127, ...	A. Willis Bartlett, Box 23, Amesbury.	Mrs. Abbie M. Babb, Amesbury.	Chas. F. Tibbetts, Amesbury.
North Andover, No. 128, . .	Albert Currier, North Andover.	Jessie Barker, North Andover.	Walter H. Hayes, North Andover.
Gardner, No. 130, ...	Lester W. Wheeler, Gardner.	Lucius W. French, Gardner.	Miss Mabel Cornwall, Gardner.
Boxborough, No. 131, . . .	L. W. Richardson, West Acton, R. F. D.	Mrs. Jennie A. Littlefield, West Acton.	Alfred W. Cobleigh, West Acton, R. F. D.

North Brookfield, No. 132,	Charles W. Witt, North Brookfield.	Mrs. Frances A. Cummings, North Brookfield.	Miss Clara A. Anderson, North Brookfield.
Berlin, No. 134,	Arthur E. Clark, Berlin, R. F. D.	Mrs. A. R. C. Parmenter, Berlin, R. F. D.	I. E. Coulson, Berlin, R. F. D.
Norfolk, No. 135,	William A. Day, Norfolk.	Edward F. Bigelow, Norfolk.	Mrs. Emma F. Holbrook, Norfolk.
East Blackstone, No. 137,	Mrs. Adelade Stearns, Blackstone, R. F. D.	Mrs. Sabra Bennett, Blackstone, R. F. D.	Mrs. Mae V. Sargent, Blackstone, R. F. D.
Northampton, No. 138,	Seth S. Warner, Northampton.	Egbert I. Clapp, Northampton.	Miss Miriam L. Allen, Northampton.
East Sandwich, No. 139,	Zebina H. Jenkins, West Barnstable.	John Bursley, West Barnstable.	Mrs. Elizabeth H. Ware, Spring Hill.
West Boxford, No. 140,	George P. Webster, West Boxford.	Mrs. Eliza R. Carver, West Boxford.	Miss Matilda B. Lund, West Boxford.
Montague, No. 141,	Charles H. Hemenway, North Leverett.	W. H. Nims, Montague.	Miss Nellie Rist, Montague.
Bolton, No. 142,	Arthur J. Whitcomb, Bolton.	Mrs. Geo. L. Taylor, Hudson.	Miss Mary A. Otterson, Bolton.
Mendon, No. 143,	Freeman C. Lowell, Mendon.	James J. Nutter, Mendon.	Herbert J. George, Mendon.
Franklin, No. 144,	John S. MacKintosh, Franklin.	Mrs. Maria L. Fisher, Wrentham.	Mrs. Alice A. Duprez, Franklin.
West Newbury, No. 146,	Albert R. Smith, West Newbury.	Mrs. Eva G. Flook, West Newbury.	Mrs. Agnes C. Smith, West Newbury.
West Springfield, No. 147,	Glenn C. Sevey, Springfield.	W. O. Parmenter, Springfield.	Grace Allen, West Springfield.
Harvard, No. 149,	Arthur T. West, Harvard.	Miss Emeline Knight, Harvard, R. F. D.	Henry A. Knight, Harvard, R. F. D.
Concord, No. 150,	Orlando E. Patch, Harvard.	Mrs. Julia Hosmer, Concord.	Mrs. S. Addie Garfield, Concord.
Agawam, No. 151,	W. H. Porter, Agawam.	Mrs. W. B. Rice, Agawam.	Mrs. C. L. Hayward, Agawam.
East Longmeadow, No. 152,	Herman W. King, East Longmeadow.	Mervin H. Pease, East Longmeadow.	Mrs. K. Adella Wood, E. Longmeadow.
Wilbraham, No. 153,	Geo. W. Hulme, Wilbraham.	Miss Ruth P. Green, Wilbraham.	Mrs. L. E. Bosworth, Ludlow, R. F. D.
Haverhill, No. 154,	Delbert H. Adams, Haverhill.	Mrs. F. E. Hall, Ayers Village.	Mrs. Grace A. Merrill, Haverhill.
Methuen, No. 155,	Chas. A. Stevens, Methuen.	Mrs. Silvia C. Hill, Methuen.	Miss Blanche A. Blodgett, Methuen.
West Bridgewater, No. 156,	Chas. M. Jefts, Brockton.	Anna M. Jefts, Brockton.	Rhoda F. Wilbur, West Bridgewater.
Granby, No. 157,	C. N. Rust, Granby.	Miss Myra F. Chapin, Granby.	Mrs. W. F. Forward, Granby.
"Nemasket" of Middleborough, No. 158.	Lawson B. Twitchell, Middleborough.	Mrs. L. B. Twitchell, Middleborough.	Mrs. Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159.	Leroy Smith, Williamstown.	Mrs. Hattie Knell, Williamstown.	Mary Evens, Williamstown.
South Hadley, No. 160,	A. R. Wilson, South Hadley, R. F. D.	Mrs. L. I. Alvord, So. Hadley, R. F. D.	I. N. Day, South Hadley.
"Laurel" of West Newbury, No. 161.	Chas. F. Brown, West Newbury, R. F. D.	Miss E. M. Forsyth, W. Newbury, R. F. D.	Miss V. T. Hibbs, W. Newbury, R. F. D.
Dartmouth, No. 162,	Charles E. Soule, Dartmouth.	Alice Davoll, Dartmouth.	Marcus M. Allen, Dartmouth.
Dudley, No. 163,	Geo. L. Penniman, Dudley.	Mrs. Mary A. Paine, Dudley.	Miss R. D. Vinton, Dudley.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Ware, No. 164, ...	Frank W. Harwood, Ware.	Mrs. Mary L. Pierce, Ware.	Mrs. Emma J. Howard, Ware, R. F. D.
Wellesley, No. 166, ...	Richmond Favour, Wellesley.	Henry M. Howard, West Newton.	Walter Clark, Natick.
Rowe, No. 167, ...	Henry D. Wright, Rowe.	Mrs. Emery Sibley, Rowe.	Mrs. Anna L. Henry, Rowe.
Somerset, No. 168, ...	C. B. Hathaway, Somerset, R. F. D.	Mrs. Augusta L. Wood, Somerset, R. F. D.	Miss Lois A. Davis, Somerset, R. F. D.
Lunenburg, No. 169, ...	Arthur Q. Emerson, Lunenburg.	Miss Ethel E. Emerson, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170, . .	Edwin L. Havens, New Braintree.	Miss Mary F. Pollard, New Braintree.	Mrs. Ida M. Havens, New Braintree.
Merrimac, No. 171, ...	Edson C. Walker, Merrimac, R. F. D.	Mrs. Frank Bartlett, Merrimac, R. F. D.	Mrs. E. C. Walker, Merrimac, R. F. D.
Ashby, No. 172, ...	Walter J. Smith, Ashby.	Mabel I. Breed, Ashby.	Ralph C. Damon, Ashby.
Hopkinton, No. 173, ...	Arthur N. Kyes, Hopkinton.	Mrs. Abbie Gowell, Hopkinton.	Miss Anna Fryberg, Hopkinton.
Brookfield, No. 174, ...	Mrs. Abbie F. Thompson, Brookfield, R. F. D.	Miss Margaret Walsh, Brookfield.	Mrs. Lottie F. Clark, Brookfield.
Athol, No. 175, ...	George E. Marshall, Athol.	Mrs. Eliza A. Proctor, Athol.	Sarah L. Smith, Athol.
"Miller's River" of Orange, No. 176.	William Eastman, Orange.	Miss Fannie Jeffries, Orange.	Mrs. Nettie M. Lindsey, Orange.
Sturbridge, No. 177, ...	Mrs. Mary Q. Ainsworth, East Brookfield.	Mrs. H. J. Ladd, Sturbridge.	Harry C. Shepard, Globe Village.
Ludlow, No. 179, ...	E. E. Chapman, Ludlow.	Mrs. Bertha Taylor, Granby.	Mrs. E. E. Chapman, Ludlow.
West Brookfield, No. 180, . .	Mrs. Nellie J. L. Canterbury, West Brookfield.	Mrs. Clara L. Haskins, West Brookfield.	Mrs. Carrie E. Webb, West Brookfield.
Westport, No. 181, ...	S. T. Brightman, Westport, R. F. D.	C. R. Macomber, Westport, R. F. D.	A. T. Potter, Westport, R. F. D.
Southbridge, No. 182, . . .	Robert A. Beckwith, Southbridge.	Jennie S. Gilbert, Southbridge.	Adella Hare, Southbridge.
Andover, No. 183, ...	Frank M. Foster, Andover.	Edw. W. Boutwell, Lowell, R. F. D.	Edw. W. Burtt, Andover, R. F. D.
Topsfield, No. 184, ...	Wm. A. Fuller, Topsfield.	Miss A. G. Bradstreet, Topsfield.	J. W. Bailey, Topsfield.
"Milton" of North Attleborough, No. 185, ...	D. B. Hunt, No. Attleborough, R. F. D.	Lewis C. Baker, South Attleborough.	Miss Ruth E. Hunt, North Attleborough, R. F. D.
Fitchburg, No. 186, ...	Herbert L. Hill, Fitchburg.	Mrs. Annie G. Cutting, Fitchburg.	Mrs. Mabelle C. Hill, Fitchburg.
Littleton, No. 188, ...	George H. Cash, Concord, R. F. D.	Burt C. Boyd, Littleton, R. F. D.	Miss M. S. Parker, Littleton Common.
Warren, No. 189, ...	Alfred A. Warriner, Warren.	John W. Williams, Warren.	Mrs. Alice M. Bliss, Warren.

Bellingham, No. 190,	Mrs. Annie I. White, Bellingham.	Miss Mabel Carter, Caryville.	Mrs. Ada H. Greenwood, Milford.
Winchendon, No. 192,	Clifford H. Foster, Winchendon.	Mrs. Anna Bosworth, Winchendon.	Chas. W. Brooks, Winchendon.
Foxborough, No. 193,	Samuel J. Johnston, Foxborough.	Francis N. Daniels, Foxborough, R. F. D.	Adella O. Drake, Foxborough.
Townsend, No. 194,	Mrs. Clara C. Flarity, Townsend.	Mrs. Emma F. Seaver, Townsend.	George A. Wilder, Townsend.
Royalston, No. 195,	C. A. Stimson, Athol, R. F. D.	Miss Cora E. Stockwell, Royalston.	Mrs. Ellen M. Stockwell, Royalston.
Easton, No. 196,	Wm. N. Howard, South Easton.	Mrs. Lynda P. Howard, South Easton.	Mrs. Emily M. Drew, North Easton.
"Brookville" of Holbrook, No. 197.	James A. Stowers, Holbrook.	Mrs. Meriel Stowers, Holbrook.	Hattie L. Shaw, Brockton.
Leominster, No. 198,	W. J. Nutting, North Leominster.	Mrs. Nutting, North Leominster.	C. F. Walker, North Leominster.
Stoughton, No. 199,	Mrs. Edna F. Tilden, Stoughton.	E. H. Gilbert, North Easton, R. F. D.	Mrs. Jennie M. Spaulding, Stoughton.
Uxbridge, No. 200,	Dr. M. R. Sharpe, Uxbridge.	Mrs. Kate Thom, Uxbridge.	Mrs. H. G. Ramsey, Uxbridge.
Bridgewater, No. 201,	Roland Cass, Bridgewater.	Mrs. Sadie Edson, Bridgewater.	Mrs. Minnie L. Swift, Bridgewater.
Ashburnham, No. 202,	Orrie L. Lane, Ashburnham.	Miss Ardella M. Jefts, Ashburnham.	Mrs. Sadie M. Fosgate, Ashburnham.
Westminster, No. 203,	Sherman Rice, Westminster, R. F. D.	Mrs. Catherine Dutton, Westminster.	Fred G. Parcher, Westminster.
Rowley, No. 204,	Mrs. Louise C. Bradstreet, Rowley.	Mrs. Alice A. Marshall, Rowley.	J. A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Leroy C. Bartlett, Center Marshfield.	Marcellus Hatch, Jr., Marshfield.	Francis T. Harlow, Marshfield.
Tewksbury, No. 207,	Harold J. Patten, Tewksbury Center.	Mrs. A. C. Dixon, Tewksbury Center.	Miss S. C. Whittemore, Tewksbury Center.
Westford, No. 208,	Samuel L. Taylor, Westford, R. F. D.	Mrs. Josie Prescott, Westford, R. F. D.	Mrs. F. C. Wright, Westford, R. F. D.
Chicopee, No. 211,	Edwin L. Shaw, Chicopee.	Miss Ida King, Willimansett.	Mrs. Edna S. Herrick, Chicopee.
"Oak Hill" of Attleborough, No. 212.	S. W. Cash, Attleborough, R. F. D.	Miss E. L. West, Attleborough, R. F. D.	Mrs. M. P. Smith, Attleborough, R. F. D.
Walpole, No. 214,	Harry A. Whiting, South Walpole.	Dwight Smith, Walpole.	Mrs. A. E. Gay, Walpole.
Mattapoisett, No. 215,	Dr. Irving N. Tilden, Mattapoisett.	Elliot R. Snow, Mattapoisett.	Mrs. Alice W. Ashley, Mattapoisett.
Dracut, No. 216,	Mrs. Alice B. Colburn, Lowell, R. F. D.	James J. MacManmon, Lowell.	Miss Rose E. Peabody, Lowell, R. F. D.
Mansfield, No. 217,	Stanley A. Bolton, Mansfield, R. F. D.	Mrs. Melissa Holt, Mansfield, R. F. D.	Howard H. Fisher, Mansfield, R. F. D.
Norton, No. 218,	Charles G. Clapp, Norton.	Miss Susan M. Barker, Norton.	Miss Laura F. Barker, Norton.
East Princeton, No. 219,	A. O. Tyler, East Princeton.	Mrs. Alwilda Drury, Princeton.	Mrs. Bessie E. French, East Princeton.
Sunderland, No. 220,	Dr. M. H. Williams, Sunderland.	Mrs. Florence Hubbard, Sunderland.	Mrs. M. A. Ward, South Deerfield.
"Anawan" of Rehoboth, No. 221,	Elmer J. Wade, Taunton.	Mrs. Amelia Carpenter, Rehoboth.	Miss Lillian Eddy, Rehoboth.
Tyngsborough, No. 222,	Chas. E. Littlehale, Tyngsborough.	Mrs. W. A. Sherburne, Tyngsborough.	Miss Lottie N. Upton, Tyngsborough.
Billerica, No. 223,	Frank H. Alexander, Wilmington.	DeLacy Corkum, Billerica.	Mrs. Cora Baker, Billerica.
Sheffield, No. 224,	F. F. Hulett, Sheffield.	W. S. Conway, Sheffield.	Z. H. Cande, Sheffield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Williamsburg, No. 225,	Frank A. Brooks, Williamsburg.	Mrs. C. R. Damon, Williamsburg.	Mrs. C. W. Warner, Haydenville, R. F. D.
West Medway, No. 226,	W. B. Bullard, West Medway.	Clinton S. Howe, West Medway.	Luella F. Moon, West Medway.
Heath, No. 227,	F. B. Burrington, Heath.	A. J. Burrington, Heath.	Miss Mary C. Burrington, Heath.
Salisbury, No. 228,	Winfred L. Pike, Salisbury.	Orrin Kimball, Newburyport.	Mrs. Mabel Kimball, Newburyport.
Cochituate, No. 229,	Rufus E. Corlew, Cochituate.	Mrs. Grace C. Loker, Cochituate.	Mrs. Gertrude D. Bishop, Cochituate.
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MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION
OF THE
MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS.

ORGANIZATION.

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NEIL F. MONAHAN, B Sc.,	*Assistant Botanist.*
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T. A. BARRY,	*Observer.*

REPORT OF THE DIRECTOR.

During the past year the work of the station has for the most part followed the usual lines, but an important change in policy, as affecting college and station, should be noted. Early last year it was voted by the Board of Trustees to separate the administrative duties of the presidency of the college and the directorship of the station, and a director was elected. The station, it will be remembered, is a department of the college, and the director, therefore, is responsible to the president. He is made *ex officio* a member of the committee of the Board of Trustees on the experiment department, without vote. Although this change, as stated, was voted early last year, it did not become practically operative until early in July, for up to that time the director-elect served as acting president of the college as well as director, so that his time and energies were divided.

THE ADAMS ACT.

The past year has been rendered notable in station history by the passage of the Adams act, granting additional appropriations to all the agricultural experiment stations of the country. This act takes its name from the late Hon. H. C. Adams of Wisconsin, who labored long and earnestly to secure its passage, and who perhaps in a very real sense gave his life for the passage of the bill which bears his name.

The Adams bill provided an appropriation by the national government of $5,000 to each experiment station for the year ended June 30, 1906. It provides for an increase of $2,000 in the amount appropriated for each station annually until the total amount per year for each State reaches $15,000, at which figure it is then to remain. This act will then, in brief, within a few years double the amount of the national appropriations to each of the experiment stations of the country. This act was approved on March 16, 1906. There was for a time doubt as to whether the first installment of $5,000 would become available during the fiscal year ended June 30 last. A final decision was not made until very late in June. The passage of the act had, however, been anticipated, and, in preparation for an increase in the scope of station work, the principal part of the first installment was used in the purchase of scientific apparatus. The Adams bill stipulates that the funds which it makes available are "to be applied only to all the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States." It should by the terms of the bill be devoted to research of the highest scientific character. No part of the funds made available by the Adams bill can be used for ordinary administrative expenses or for publication.

The bill was so drawn that acceptance of its provisions by the Legislatures of the several States was a necessary prerequisite to the reception of the funds which it provided. Such acceptance on the part of the Legislature of Massachusetts was promptly obtained.

Change in the Name of the Station.

At the time when work was organized under the Hatch act, establishing experiment stations as departments of agricultural colleges, there was already in existence in Amherst a station organized under State law, known as the Massachusetts Experiment Station. It will be remembered that for some years the two stations continued in operation side by side and without disadvantage, for there was agreement as to the lines of investigation to be undertaken by each, and there was no duplication of work. The fact that the name Massachusetts Experiment Station was already in use made it necessary to adopt another name; and, as a mark of respect to Senator Hatch, to whose activity and influence the establishment of the stations under the general government had been due, this experiment department in Massachusetts was called the Hatch Experiment Station. In the course of a few years it became apparent that superior economy in the administrative work of the Massachusetts stations might be secured should both come under one organization. An act of the Legislature was secured, uniting the State station with the Hatch station, and under the latter name. The use of this name has been attended with numerous minor disadvantages. The reason for its adoption is not generally understood. It is contrary to the custom in other States to give the stations a special name; in all other States the station is known by the name of the State. It has therefore seemed best to conform to this general practice, and the name of this station by act of the Legislature recently secured has been changed to the Massachusetts Agricultural Experiment Station.

Changes in Staff.

No very important changes in the general policy of the station have been made during the year, and yet it has been a year of progress. The station has been fortunate in retaining the services of all the heads of its various divisions, and in June last the scope of its work was extended through the establishment of a division of veterinary science, of which Dr. James B. Paige was made the head.

A considerable number of minor changes in the station staff have been made necessary, owing to the fact that assistants in various departments have left us to take positions of greater responsibility and emolument. These changes have been as follows: —

E. S. Fulton, B.S., in place of F. R. Church, B.S.

E. F. Gaskill, B.S., appointed assistant agriculturist, in place of S. B. Haskell, B.S.

Howard S. Parsons, dairy tester, in place of Sumner R. Parker, B.S.

Charles P. Halligan, B.S., assistant horticulturist, in place of Walter B. Hatch, B.S.

Lewell S. Walker, B.S., assistant chemist, in place of Arthur C. Whittier, B.S.

W. K. Hepburn, inspector, in place of Frank G. Helyar, B.S.

T. A. Barry, observer, in place of C. H. Chadwick.

The correspondence, as pointed out by the heads of a number of divisions, has largely increased. This increase has affected not simply the heads of divisions, but the director's office as well, and has made necessary the employment of an increased number of private secretaries. The clerical work of the station now affords full employment for from five to six such assistants.

New Lines of Work.

During the past year two new lines of work have been undertaken, in both instances at the solicitation and with the hearty co-operation of persons engaged in the special industries affected.

Asparagus growing is an important industry in a number of sections. Of late years it has been found difficult to produce satisfactory crops, on account of the prevalence of rust. It is hoped that it may be possible to obtain or to produce more rust-resistant varieties of this crop; and, for the purpose of working with that end in view, an arrangement has been made with the division of plant industry of the department of agriculture for co-operative work. Much of this work will be carried on in Concord, which is the center of what is without doubt the most important asparagus-producing section in the State. In connection with the asparagus-breeding experiments in Concord, an extended series of fertilizer experiments is also to be undertaken. Considerable preliminary work in both directions has been done during the past year.

The cranberry industry, which is so important chiefly in the seaboard towns of southeastern Massachusetts, has long suffered from a variety of insect pests. An important beginning has been made in the study of these pests during the past season. In this work the station has employed an assistant, who spent the entire summer in Wareham, which is one of the principal towns of the cranberry district of Plymouth County. The results of his work and important suggestions as to methods of fighting the injury due to some of the more serious insect pests will be presented in a bulletin, which will be ready for publication at an early date.

An extended series of experiments in the use of fertilizers for cranberries has also been begun during the past year. The bogs where these experiments are in progress under direct station management are located in Falmouth. An almost equally extensive series of experiments with fertilizers has been begun on the bogs of one of the largest private growers.

Revision of Mailing Lists.

The mailing lists of the station have been kept by the card catalogue system, and have not been revised for a number of years. These lists include a total of some 25,000 cards. It is believed that they may include duplicates, and a considerable number of names of parties who no longer care for our publications, — possibly of persons deceased or removed. An important beginning has been made in the revising of these lists. The revision now in progress will be made of the most thorough possible character, and as soon as it can be completed, improved systems of addressing and mailing will be installed.

Work under the Adams Act.

Careful plans have been laid for investigations under the Adams act. These investigations, as will be evident from the statement made concerning the nature of the work which can be undertaken under it, will usually extend over a considerable number of years. A portion of the work with asparagus and cranberries, which has been referred to, will be provided for out of the funds furnished by this act.

Among other lines of work which have been begun are investigations to determine the effect of feed on the composition of milk and butter fat and on the consistency or body of butter; the effect of Porto Rico molasses on the digestibility of hay, and of hay and a nitrogenous concentrate; the preparation of descriptions and life histories of important groups of insects; and a study of the relations of climate to the development of plants and crops both in health and disease.

BULLETINS ISSUED.

Meteorological bulletins have been issued monthly, as usual, and in addition the station has published and distributed four other bulletins, — two on fertilizers, one on the inspection of concentrates and one on market milk.

The fertilizer bulletins, Nos. 109 and 111, have presented the analyses of the fertilizers officially examined under the fertilizer law, as well as the analyses of a considerable number of soils and the more abundant miscellaneous materials possessing fertilizer value, which are sent in by the general public. They have also included brief discussions of the results.

The bulletin on the inspection of concentrates, No. 108, besides presenting the results of the analyses of food stuffs collected under the feed law, included much valuable information on the general subject of food stuffs and their use.

The bulletin on market milk, No. 110, included: first, general discussion of the composition and value of milk as food; second, it presented the results of an examination into the conditions under which the milk marketed in parts of Northampton and Amherst is produced, as well as the results of a critical examination of samples of this milk. The milk was subjected to physical, chemical and bacteriological tests, for the purpose of determining its quality, value and suitability as human food. The results are carefully and fully discussed, and some of the more important conclusions presented were as follows: Very little milk showed evidence of adulteration, and most of it was sweet. The larger part of it was above the average in chemical composition. Bacteria were especially numerous in the product of cows kept under uncleanly conditions, and such samples were far too numerous. Many samples showed barny or disagreeable smell, apparently due to the fact that the milk was allowed to stand too long in the stable after milking. The general conclusion was, that a great deal of the milk offered for general consumption was not produced under satisfactory sanitary conditions. The bulletin concludes with brief, important and pointed practical suggestions both to producers and to consumers.

Besides the bulletins which have been mentioned, three others have been prepared, and are now in press: No. 112, "The Examination of Cattle and Poultry Feeds;" No. 113, "Fertilizer Bulletin;" and No. 114, "The Oriental Moth: a Recent Importation."

Bulletins and Reports available for Free Distribution.

The supply of many of the reports and bulletins which have been issued by the station, available for general distribution, has been exhausted, but those in the following list will still be furnished on application: —

No. 3.	Tuberculosis.
No. 33.	Glossary of fodder terms.
No. 34.	Fertilizer analyses.
No. 41.	On the use of tuberculin (translated from Dr. Bang).
No. 64.	Analyses of concentrated feed stuffs.
No. 68.	Fertilizer analyses.
No. 76.	The imported elm-leaf beetle.
No. 81.	Fertilizer analyses; treatment of barnyard manure with absorbents; trade values of fertilizing ingredients.
No. 83.	Fertilizer analyses.
No. 84.	Fertilizer analyses.
No. 89.	Fertilizer analyses; ash analyses of plants; instructions regarding sampling of materials to be forwarded for analysis.
No. 90.	Fertilizer analyses.
No. 92.	Fertilizer analyses.
No. 96.	Fungicides; insecticides; spraying calendar.
No. 97.	A farm wood lot.
No. 99.	Dried molasses beet pulp; the nutrition of horses.
No. 100.	Fertilizer analyses; market values of fertilizing ingredients.
No. 102.	Analyses of manurial substances and fertilizers; market values of fertilizing ingredients.
No. 103.	Analyses of manurial substances; instructions regarding sampling of materials to be forwarded for analysis; instructions to manufacturers, importers, agents and sellers of commercial fertilizers; discussion of trade values of fertilizing ingredients.
No. 105.	Tomatoes under glass; methods of pruning tomatoes.

No. 107. Analyses of manurial substances forwarded for examination; market values of fertilizing ingredients; analyses of licensed fertilizers collected in the general markets.
No. 109. Analyses of manurial substances forwarded for examination; analyses of Paris green and other insecticides found in the general markets; instructions regarding the sampling of materials to be forwarded for analysis; instructions to manufacturers, importers, agents and sellers of commercial fertilizers; discussion of trade values of fertilizing ingredients for 1906.
No. 110. Market milk.
No. 112. The examination of cattle and poultry feeds.
No. 113. Fertilizer analyses.
No. 114. The oriental moth: a recent importation.

Of most of the other bulletins of the station a few copies still remain; these will be supplied only to complete sets for libraries.

The co-operation and assistance of farmers, fruit growers and horticulturists, and all interested directly or indirectly in agriculture, is earnestly requested. Communications may be addressed to the "Massachusetts Agricultural Experiment Station, Amherst, Mass."

Reports of Divisions.

The reports of the different heads of divisions are transmitted herewith.

The report of the meteorologist calls attention to two or three important improvements in equipment.

The report of the agriculturist is elsewhere briefly summarized.

The report of the fertilizer section of the division of chemistry calls attention to a moderate increase in the number of fertilizers licensed in the State and in the number analyzed. Three hundred and fifty-four brands of fertilizers and chemicals have been licensed in Massachusetts during the year. As was pointed out in the last annual report, there can be no possible necessity for such a large number of different kinds of fertilizers. The report of the chemist this year emphasizes this point. It should be more generally understood that the fertilizers purchased by the farmer cost more as a consequence of this needless multiplication of brands. It would seem to be the part of common sense for the manufacturers to reduce their number, for whatever enables them to lower the price to the consumer must eventually help manufacturer and dealer as well as consumer. The fertilizers analyzed during the past year have shown an improvement in quality, as compared with stated composition. No particular improvement can be noted in the direction of better adaptation to crops. The different brands of special crop fertilizers show the same extreme variations as heretofore. It is evident that not all of the fertilizers advertised as suitable for any particular crop can possibly meet the promises of the manufacturers. The analyses completed by the station show some decline in the general quality of wood ashes, and the report emphasizes the desirability that consumers of ashes should purchase only on a guarantee as to quality.

The report of the section of foods and feeding is largely devoted to the presentation of the results of experiments to determine the digestibility of some of the newer food stuffs. The publication of such results seems to be essential as a basis for proper use of such materials. The report calls attention to the general results of the analyses of samples of drinking water, which indicate, as in previous years, the necessity of caution in cases where contamination seems possible or is suspected. The report includes also brief statements of the results of the execution of the feed and dairy laws. Dealers in food stuffs seem in general disposed to comply with the law, although in a few cases it is believed that retailers are in the habit of removing or failing to attach labels required by the law. Attention is called to the fact that the tests of Babcock glassware for accuracy show a comparatively large proportion to be inaccurately graduated. There is much need of greater care on the part of manufacturers.

The results of a feeding trial in which Porto Rico molasses was tested are presented. They show such molasses to have apparently about 80 per cent. of the value of corn meal. Attention, however, is called to the fact that molasses depresses the digestibility of other foods. Should it be found that such depression inevitably follows the use of molasses, this consideration will materially decrease its value as a food stuff.

Feeding experiments with alfalfa meal indicate that it is not equal to wheat bran in food value, as is claimed by some of its manufacturers.

Experiments with sorghum as a fodder show that the large quantities of seed sometimes recommended are unnecessary, and that the fodder fills a useful place in a soiling system.

The report of the botanist and vegetable pathologist covers a considerable variety of topics. Attention is called to the tonic influence of Bordeaux mixture on plant assimilation. As a result of this influence, it seems apparent that the benefit following the application of Bordeaux mixture is not due solely to the prevention of disease, but in considerable measure as well to increased vigor of growth.

Attention is called to the importance of further study for the discovery of a remedy for tomato rot, which so seriously injures the greenhouse crop in this State.

The report shows a considerable increase in the amount of work done by the station in testing seeds for farmers and gardeners. It presents a review of the year as regards the prevalence of plant diseases. It seems that during the past year the potato has been comparatively free from disease, while celery, pears and apples have been affected to an unusual degree. The report calls attention to defoliation of fruit trees not infrequently following improper spraying, and makes important suggestions in connection therewith.

Attention is called to a bacterial disease of cucumbers under glass. It has been found that relatively late planting insures absolute or comparative freedom from this disease. A bacterial disease of lettuce is common in the south, and growers are cautioned to be on the outlook for similar disease in their houses. The promptest measures should be taken to eradicate it, should it appear.

Attention is called to a serious trouble which tobacco growers have experienced within the last year or two, which appears to be due to improper use of fertilizers.

It is pointed out that the lime and sulfur treatment now so often adopted as a means of destroying the San José scale exercises a repressive influence upon a number of fungous diseases. It has been noted that fruit trees have been remarkably free from such diseases, and the fruit unusually perfect and free from imperfections where the lime and sulfur treatment has been practiced, and the opinion is expressed that the San José scale may prove "a blessing in disguise."

A brief report is presented of the trial of a number of different fungicides for potatoes. The wet Bordeaux mixture was found to be superior to any of the dry applications, but the results of the season are comparatively inconclusive.

The report includes an important paper upon banding substances which are used for the protection of trees and shrubs from insects. Relatively few of the substances upon the market satisfy all the requirements in such a material. A number of them prove highly injurious if applied direct to the bark.

The report of the botanist includes a paper on the injury to trees caused by illuminating gas. It appears that a large amount of careless work has been done in the putting in of gas mains. The injury to trees consequent upon the escape of illuminating gas into the soil surrounding their roots has in a number of instances proved very serious.

The report concludes with a discussion as to the varying texture of soil required for some of our more important special crops.

The report of the entomologists calls attention to the large amount of injury to various greenhouse crops consequent upon the attacks of the white fly. Fumigation with hydrocyanic acid gas has been found the most successful method of destroying this insect, but the results of such fumigation have in numerous instances resulted in great injury to the plants fumigated. The capacity of different plants to endure such fumigation is for the most part unknown. This subject has been carefully investigated for greenhouse tomatoes, and a bulletin soon to be published will present the results and give definite directions. The report calls attention to the rapid spread of the San José scale, which seems to be at present distributed in nearly every town east of the Connecticut River. The scale is found in old as well as in recently set trees. The report calls attention to the fact that earlier experiments here showed the lime and sulfur treatment to be the most effective. Later investigation confirms these early results. The report deals briefly with a number of the proprietary mixtures recommended for the destruction of the San José scale, but states that none of them has been found equal to the lime and sulfur mixture. The report makes mention of the work on cranberry insects and the investigation as to the newly imported oriental moth, both of which have been previously referred to. It concludes with brief reference to some of the more destructive insects of the year.

The report of the veterinarian briefly discusses the nature of the work which his department has been called upon to do. It will be remembered that this division has been organized only since July.

The report of the horticulturist makes brief mention of the different lines of experimental work in progress, and reports in detail the results of experiments in mushroom growing. These indicate pure-culture spawn to be much superior to the ordinary commercial spawn, and that there is a wide difference in the characteristics of different varieties as regards productiveness and quality. The results indicate that the possibilities of profit in mushroom culture are by no means as great as is often represented.

WILLIAM P. BROOKS,
Director.

ANNUAL REPORT

Of George F. Mills, *Treasurer* of the Massachusetts Agricultural Experiment Station of the Massachusetts Agricultural College,

For the Year ending June 30, 1906.

Cash received from United States Treasurer,		$14,617 70
Unexpended balance, 1904–05,		382 30
		$15,000 00
Cash paid for salaries,	$6,539 52	
for labor,	3,003 07	
for publications,	719 01	
for postage and stationery,	438 09	
for freight and express,	168 01	
for heat, light, water and power,	245 42	
for chemical supplies,	406 54	
for seeds, plants and sundry supplies,	525 57	
for fertilizers,	569 43	
for feeding stuffs,	699 10	
for library,	21 10	
for tools, implements and machinery,	246 05	
for furniture and fixtures,	51 52	
for scientific apparatus,	292 62	
for live stock,	195 25	
for travelling expenses,	229 66	
for contingent expenses,	25 00	
for building and repairs,	625 04	
		$15,000 00
Cash received from State Treasurer,	$13,500 00	
from fertilizer fees,	4,745 00	
from farm products,	2,836 02	
from miscellaneous sources,	4,993 76	
		$26,074 78

Cash paid	for salaries,	$13,411 67	
	for labor,	2,220 35	
	for publications,	809 52	
	for postage and stationery,	394 61	
	for freight and express,	186 63	
	for heat, light, water and power,	1,118 36	
	for chemical supplies,	237 79	
	for seeds, plants and sundry supplies,	680 65	
	for fertilizers,	67 55	
	for feeding stuffs,	902 65	
	for library,	142 60	
	for tools, implements and machinery,	58 10	
	for furniture and fixtures,	212 13	
	for scientific apparatus,	1,210 72	
	for live stock,	10 00	
	for travelling expenses,	1,587 59	
	for contingent expenses,	88 10	
	for buildings and repairs,	170 47	
Balance,		2,495 29	
			$26,074 78

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

The work of the meteorological division during the past year has been continued along the same lines as in previous years. While changes in the instruments at times are necessary, and a modification in the form of the records must occasionally be made, these are avoided unless the necessity is very apparent. The value of a set of records at any station is dependent on the uniformity with which they have been made, as well as on the length of time covered. Notwithstanding the objections to a change, it was considered advisable at the beginning of the year to discontinue the publication of the wind movement as given by the Draper anemometer, and to use instead that given by the electric register which was installed last year. This was done so that our records would be better comparable with those of the United States Weather Bureau meteorological stations, which use electric recorders. A comparison of the two records at this station shows a difference of from 5 to 10 per cent. in the total movement during a month, that of the electric register usually being the larger. The Draper records are still taken, and will be continued during the coming year for the purpose of further comparison.

The records of the electric sunshine recorder have been substituted for those of the Draper instrument, and, while they are made more precise, it is not thought that the monthly results are materially affected by the change.

With the close of the year the records for eighteen years will be complete. A summary of the records for the first ten years was published in the report for 1900. This summary has been carried along to date for the purpose of deducing mean values which are taken for the normals of the station. It should again be published when the records for twenty years are completed.

The usual monthly bulletins have been issued, and the one for December will contain a summary of the records for the year. The station has also furnished the Boston office of the United States Weather Bureau with the monthly voluntary observers' reports, and has arranged to send weekly snow reports during the winter season.

The local forecasts are received by telegraph daily, Sundays excepted, from the Boston office, and the proper flags are displayed.

During the year a new Draper self-recording thermometer was purchased, to replace the one in use. A new maximum thermometer of standard pattern was purchased, to replace the one in use which was broken in resetting. A Felt and Tarrent comptometer has been added to the equipment, and is used in making many of the computations. All computations are checked, to reduce the probability of errors to a minimum.

In February Mr. C. H. Chadwick, the observer, retired to accept a position in civil engineering in the south; and the assistant observer, Mr. T. A. Barry, was advanced to the place.

REPORT OF THE AGRICULTURIST.

WM. P. BROOKS; ASSISTANTS, E. S. FULTON, E. F. GASKILL.

The work carried on in the agricultural division of the experiment station during the past season has involved the care of 308 field plots in the various fertilizer and variety tests; 150 closed plots, largely used in fertilizer experiments; and 286 pots in vegetation experiments, mainly designed to throw light upon problems connected with the use of fertilizers. It will be remembered that a large number of the experiments in this division are continued from year to year. Such repetitions are desirable, for reasons which are fully set forth in the last annual report. A detailed account of results obtained will at this time be presented only for a relatively small number of the experiments in progress. The experiments discussed, and the more important results, briefly stated, are as follows: —

I. — Experiment to determine the relative value as sources of nitrogen of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. This experiment has been in progress since 1890. The crop of this year was corn, and on the basis of yield the nitrogen materials under comparison rank in the following order: barnyard manure, nitrate of soda, sulfate of ammonia, dried blood. On the basis of increase in crop, as compared with the product of the no-nitrogen plots, taking into account all the crops grown since the experiment began (1890), the materials on a percentage basis rank as follows: nitrate of soda, 100; barnyard manure, 85.31; dried blood, 70.06; sulfate of ammonia, 63.54.

II. — Experiment to determine the relative value of muriate and high-grade sulfate of potash. The crops on the basis of which comparisons are possible this year were soy beans, asparagus, rhubarb, raspberries, blackberries, mixed hay and potatoes. The sulfate of potash gives the larger crops in the case of soy beans, rhubarb, raspberries, blackberries, potatoes, and (as the average of two experiments) for mixed hay. The muriate gives the larger crop of asparagus.

III. — Experiment to determine the relative value of different potash salts for field crops. The salts under comparison were kainit, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate and silicate. The crop was potatoes. The salts on the average of five trials for each rank as follows: muriate, low-grade sulfate, high-grade sulfate, nitrate, carbonate, kainit and silicate. Where potash is not used as a fertilizer, the vines appear to be far more susceptible to early blight than on the other plots.

IV. — Experiment to show the relative value in corn and hay production of special corn fertilizers, as compared with a fertilizer mixture richer in potash. The crop of the past season was mixed grass and clover. The special corn fertilizer gave the larger yield at the first cutting, the fertilizer richer in potash the larger yield of rowen. This experiment has continued since 1891. Ten corn crops and six crops each of hay and rowen have been produced. As the average of the entire number of experiments, the special corn fertilizer has given a slightly larger yield of grain and less stover than the mixture of materials richer in potash. As the average of six years' results, the mixture richer in potash has given the larger crops both of hay and rowen.

V. — Experiment to determine the relative value for production of corn and mixed hay of manure alone, as compared with a smaller application of manure and a moderate amount of sulfate of potash. The crop of the past year was mixed hay. The larger application of manure alone gave slightly larger yields both at the first and second cuttings than the combination of the smaller amount of manure and potash. This experiment has continued sixteen years. Ten corn crops and six crops each of hay and rowen have been harvested. The average yields both of corn and hay have been greater on the larger amount of manure alone, but not sufficiently greater, estimating the manure to cost $5 per cord, to cover the larger cost of the manure applied to those plots where it is used alone.

VI. — Experiment to determine the relative value, as measured by crop production, of a considerable number of phosphates used in quantities to furnish equal phosphoric acid to each plot. The phosphates under comparison are fine ground, — apatite, South Carolina rock and Tennessee rock phosphates; Florida soft phosphate, basic slag meal, dissolved bone black, raw bone meal, dissolved bone meal, steamed bone meal and acid phosphate. The crop of the past season was mixed hay. The yields on the different phosphates varied relatively little, indicating that the hay crop is dependent in far less degree upon the quantity of available phosphoric acid applied than are the crops belonging to the Cruciferæ, such as cabbages and turnips, as shown by previous trials.

VII. — Soil tests. The past season was the eighteenth during which the soil test reported in detail has continued. The results show the great importance of a supply of nitrogen in highly available form for the production of a satisfactory hay crop.

VIII. — Experiment in applying manurial substances in rotation for the production of grass. The materials applied in the rotation are: first, barnyard manure; second, wood ashes; and third, a combination of fine-ground bone and potash. The average yield of hay during the past season was at the rate of 4,002 pounds per acre. The average for the fourteen years during which the experiment has continued has been 6,389 pounds.

IX. — An experiment comparing winter with spring application of manure on a slope. The crop of the past year was corn, and the results indicate a small loss in fertilizer value, resulting from winter application, but the gain in crop where the manure was applied in spring was not sufficient to repay the extra cost in handling the manure in that manner.

X. — Experiment in the application of nitrate of soda for rowen. The increase in crop during the past season was considerably more than sufficient to cover the cost of the application; but the results in the different years that the experiment has continued show a wide variation with the amount of rainfall during the season of growth of the crop.

XI. — A variety test of potatoes, including twenty-five varieties. The most productive varieties, mentioned in order, were: Climax, Chenango White, Hammond's Wonderful and Simmon's Model, all of which gave a yield in excess of 200 bushels merchantable potatoes per acre.

XII. — Comparisons of food combinations furnishing the essential nutrients in varying proportions for laying hens. The results indicate corn to have superior merit among the different grains for the production of eggs whenever the total fiber content of the ration is low, and the fat content relatively high. Rice, which contains less fiber than any other grain, gives a satisfactory egg product, but costs too much to render its use advisable.

I. — Manures and Fertilizers furnishing Nitrogen compared. (Field A.)

The materials furnishing nitrogen which are under comparison in this experiment are barnyard manure, nitrate of soda, sulfate of ammonia and dried blood. With few and unimportant exceptions, each plot has been manured in the same way since 1890. The field includes eleven plots, of one-tenth acre each. All the plots annually receive equal and liberal amounts of phosphoric acid and potash. The phosphoric acid is supplied to all plots in the form of dissolved bone black. The potash is applied to six plots (1, 3, 6, 7, 8 and 9) in the form of muriate; it is applied to four plots (2, 4, 5, and 10) in the form of low-grade sulfate. There are three plots in the field which have had no nitrogen applied to them in any form since 1884. The nitrogen materials under comparison are applied in such quantities as to furnish nitrogen at the rate of 45 pounds per acre to each. Barnyard manure is used on one plot, nitrate of soda on two, sulfate of ammonia on three and dried blood on two.

The plots to which nitrogen has been applied in the form of sulfate of ammonia have shown a tendency to comparative unproductiveness, due without doubt to unfavorable chemical or biological conditions. These unfavorable conditions have apparently tended to prevent or to retard the nitrification of the ammonia nitrogen. As a means of correcting the faulty conditions, 50 pounds of unslaked lime were applied to plot

6 in 1896. Twice since that date, in 1898 and in 1905, the entire field has been limed, as observation of the growth of the crops, especially of clover, indicated that liming would be beneficial. In 1898, lime was applied at the rate of 2,000 pounds per acre of air-slaked lime. In 1905, 2,395 pounds of slaked lime were applied to the entire field, this being at the rate of a little more than a ton to the acre.

The crops grown in this experiment previous to this year in the order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes, soy beans, potatoes, oats and peas.

The crop of the past season was Rustler White Dent corn, the seed having been obtained in Minnesota. It may be here remarked that this variety seems to be well adapted to our local soil and climatic conditions. It gave a thoroughly matured crop and a heavy yield.

After the harvest of the crop of the season 1905 (oats and peas), the land was replowed and sown to clover late in August. This clover made a poor start, and was badly injured by the winter. The condition in the spring was best on plot 0 (manure). It was poorest on plots 5 and 6 (sulfate of ammonia). On these there were but few living plants remaining. The condition of the clover being so poor, the field was plowed on May 18. The manure and the fertilizers were applied in accordance with the regular system on May 21. The field was harrowed thoroughly on May 22 and 23; it was planted on the 23d. The crop was thoroughly cared for, and no exceptional conditions likely to interfere with the experiment were noted. The rates of yield on the several plots and the sources of nitrogen on each are shown in the following table: —

Yield of Corn and Stover per Acre.

Plots.	Nitrogen Fertilizers used.	Corn (Bushels).		Stover (Pounds).
		First Quality.	Second Quality.	
0,	Barnyard manure,	86.71	16.14	6,500
1,	Nitrate of soda (muriate of potash),	62.14	13.57	6,300
2,	Nitrate of soda (sulfate of potash),	70.00	14.00	6,100
3,	Dried blood (muriate of potash),	62.43	10.43	6,000
4,	No nitrogen (sulfate of potash),	34.29	13.86	6,200
5,	Sulfate of ammonia (sulfate of potash),	62.57	10.00	5,400
6,	Sulfate of ammonia (muriate of potash),	62.86	9.86	5,350
7,	No nitrogen (muriate of potash),	35.00	10.00	5,350
8,	Sulfate of ammonia (muriate of potash),	61.71	12.86	5,930
9,	No nitrogen (muriate of potash),	29.29	15.71	5,600
10,	Dried blood (sulfate of potash),	57.71	12.57	5,800

The yield on the three no-nitrogen plots (4, 7 and 9) is much inferior to that on any of the others, although it is still almost equal to the average rate of yield of corn per acre in this State. The yield on all the plots receiving nitrogen was good, but wide differences will be noticed. The plot to which manure was applied gave a yield much superior to that obtained on any of the other plots. The relative rank of the manure plot with most of the crops grown has been much lower. In corn, as is well understood, we have a crop capable, in unusual degree, of utilizing the nitrogen of our coarser manures, since its principal growth occurs at a season sufficiently late so that the nitrogen of the comparatively inert organic compounds of the manure can previously have been rendered available by the natural processes of decay and nitrification, for which the warm weather of the early and mid-summer months is so favorable.

The average yields of this year on the several fertilizers are shown in the following table: —

FERTILIZERS USED.	CORN (BUSHELS).		Stover (Pounds).
	First Quality.	Second Quality.	
Average of no-nitrogen plots (4, 7, 9),	32.86	13.19	5,717
Average of the nitrate of soda plots (1, 2),	66.07	13.79	6,200
Average of the dried blood plots (3, 10),	60.07	11.50	5,900
Average of the sulfate of ammonia plots (5, 6, 8),	62.38	10.90	5,560

As a result of all the experiments previous to this year, it has been found that the materials furnishing nitrogen have produced crops in the following relative amounts: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	94.47
Dried blood,	91.09
Sulfate of ammonia,	88.83
No nitrogen,	71.52

Similar averages for this year are as follows: —

	Per Cent.	
	Corn.	Stover.
Nitrate of soda,	100.00	100.00
Barnyard manure,	131.24	104.83
Sulfate of ammonia,	94.41	89.68
Dried blood,	90.92	95.16
No nitrogen,	49.73	92.20

If we combine the results showing relative standing in 1906 with the similar figures for all the years previous to 1906, the relative standing is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	96.63
Dried blood,	91.08
Sulfate of ammonia,	89.14
No nitrogen,	70.24

All the figures showing relative standing included in the above tables are based upon the total yields. Presented in this way, they are not without interest. Of even greater interest, however, will be a comparison on the basis of the increases as compared with the no-nitrogen plots, due to the different nitrogen-containing materials which have been used. On this basis, increase in crop, rather than on the basis of total product, the manure and fertilizers used as a source of nitrogen rank to date for the entire period of the experiment, 1890 to 1906, inclusive, as follows: —

Relative Increases in Yields (Averages for the Seventeen Years).

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	85.32
Dried blood,	70.03
Sulfate of ammonia,	63.51

It will be noticed that, whatever the basis of comparison, the nitrate of soda has on the average given results considerably superior to those obtained either with manure or with either of the other nitrogen fertilizers. It will also be noticed that the sulfate of ammonia, on the other hand, has given results much inferior to those obtained with either of the other materials supplying nitrogen. If nitrogen, then, can be purchased in the form of nitrate at a price per unit not exceeding that which it will cost in other forms, there can be little doubt that it should be depended upon as a source of this element for most of the crops of the farm. The results of the past season, however, indicate that, as would naturally be anticipated, the nitrate does not show the same degree of superiority for corn as has usually been shown with the crops raised in this field, almost all of which complete their growth at a much earlier date in the season than corn.

II. — THE RELATIVE VALUE OF MURIATE AND HIGH-GRADE SULFATE OF POTASH. (FIELD B.)

In this experiment, muriate of potash is compared with the high-grade sulfate on the basis of such applications as will furnish equal actual potash per acre. These potash salts are used in connection with bone meal at the rate of 600 pounds per acre. The experiment was begun in 1892. During the first eight or nine years, potash salts were applied in varying quantities, but for the most part at the rate of about 350 to 400 pounds per acre. Since 1900, each has been applied annually at the rate of 250 pounds per acre. There are ten plots in the field, each containing about one-seventh of an acre. Five of these plots receive muriate of potash, and these plots alternate with the same number of plots which are yearly manured with sulfate of potash.

A large variety of crops has been grown in the different years during which this experiment has continued. The crops of the past year were asparagus, rhubarb, raspberries, blackberries, mixed hay, potatoes and soy beans. On each of plots 13 and 14 four different perennial crops are grown, namely, asparagus, rhubarb, raspberries and blackberries, each crop occupying substantially one-quarter of the area. The hay crop occupied four plots, the potatoes and soy beans two each.

No accidental conditions were observed which unfavorably influenced any of the crops. It is believed that the differences shown by the table giving the yields are due to the difference in potash salt employed. The rates of yield per acre of the various crops on the different fertilizers are presented in the following table: —

Crops.	Fertilizer used.	Plots.	Yield per Acre.	
			Beans.	Straw.
Soy beans,	Muriate of potash,	11	23.83 bush.	2,419 lbs.
	Sulfate of potash,	12	28.44 bush.	2,887 lbs.
Asparagus,	Muriate of potash,	13	2,649.7 lbs.	
	Sulfate of potash,	14	1,730.3 lbs.	
			Stalks.	Leaves.
Rhubarb,	Muriate of potash,	13	23,999 lbs.	20,733 lbs.
	Sulfate of potash,	14	40,992 lbs.	33,148 lbs.
Raspberries,	Muriate of potash,	13	57.26 lbs.	
	Sulfate of potash,	14	151.82 lbs.	
Blackberries,	Muriate of potash,	13	266.00 lbs.	
	Sulfate of potash,	14	857.90 lbs.	
			Hay.	Rowen.
Hay,	Muriate of potash,	15	2,438 lbs.	2,000 lbs.
	Sulfate of potash,	16	2,261 lbs.	1,911 lbs.
Hay,	Muriate of potash,	17	2,045 lbs.	1,981 lbs.
	Sulfate of potash,	18	2,709 lbs.	2,046 lbs.
			Large.	Small.
Potatoes,	Muriate of potash,	19	158.1 bush.	25.2 bush.
	Sulfate of potash,	20	180.8 bush.	28.5 bush.

Soy Beans. — The yield of soy beans, as will be noticed, was considerably larger upon the sulfate of potash. We have now carried through a similar experiment with soy beans fifteen times. In seven of these trials the result has been favorable to the sulfate of potash, and in one it was the same on the two salts. The average of all trials is favorable to the sulfate, and it would seem that there can be little doubt that where the two potash salts are continuously used the sulfate rather than the muriate should be selected. The superiority in yield on the former is usually much more than sufficient to cover the small additional cost of that salt, as compared with the muriate.

Asparagus. — It will be noticed that the yield of asparagus on the muriate of potash is more than 50 per cent. greater than on the sulfate. This result in so far as it goes appears to furnish evidence that the customary practice of depending largely upon the muriate as a source of potash for the asparagus crop is sound.

Rhubarb. — The yield of rhubarb this year is much larger than in any preceding year during which this crop has been grown in this experiment. In the earlier years the yield on the sulfate of potash has been moderately greater than on the muriate; this year it is very much greater, exceeding the yield on the muriate by about 80 per cent. Should further experiment support the evidence afforded thus far by this, it would appear that rhubarb growers in general will be wise to depend upon the sulfate rather than the muriate as a source of potash for that crop.

Raspberries and Blackberries. — The yield of both these crops is small on both fertilizers, that of raspberries especially so. During the three or four years the experiment on these plots has continued, the sulfate has invariably given better results than the muriate. Particularly noticeable has been the difference in the degree of winter-killing. The canes upon the plot to which muriate of potash is applied seem to be much less hardy than those on the plot where sulfate is used; and, with little doubt, the greater yield on the latter potash salt is mainly a consequence of the fact that the injury due to winter-killing is so much less.

Should further experiment confirm what now appears to be probable in regard to the varying effect of these two potash salts upon the ability of the canes of these fruits to resist the winter's cold, the point demonstrated will be one of much importance, for winter-killing is one of the most serious obstacles to the successful production of some of the most desirable varieties of these fruits.

The Hay Crops. — The hay crop of the past year occupied four plots. Clover seed alone was sown, but the clover did not make a good stand, and the vacancies were filled in part by timothy, in part by weeds. Where the clover was best, a considerable superiority in favor of the sulfate of potash was manifest. Aside from this observation, the results of the year with the hay crop did not appear to have much significance.

Potatoes. — It will be noted that the yield of merchantable potatoes upon the sulfate of potash was materially larger than on the muriate. This result is in accordance with the results which have usually been obtained in experiments upon our grounds; and, in spite of the fact that the season during which the potatoes made their chief growth was this year characterized by a considerable deficiency of rainfall, the soil where the sulfate has been continuously used shows its superiority over that where the muriate has been similarly used.

III. — Comparison of Different Potash Salts for Field Crops. (Field G.)

This experiment is designed to show the ultimate effect upon the soil, as well as the current effect upon the crops, of continuous use of different potash salts. We have under comparison kainit, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate and silicate. The field includes forty plots, in five series of eight plots each. Each series includes a no-potash plot, as well as the seven potash salts which have been named. The experiment is therefore carried out each year in quintuplicate. The area of each plot is one-fortieth of an acre. The potash salts under comparison are used in quantities which will supply annually actual potash at the rate of 165 pounds per acre to each of the plots. All plots are equally manured, and liberally, with materials furnishing nitrogen and phosphoric acid.

The crops which have been grown in this field in the order of their succession beginning in 1898 have been as follows: —

1898. Medium Green soy beans.
1899. Potatoes.
1900. Plots 1–8, cabbage; 9–24, Medium Green soy beans; 25–40, cowpeas.
1901. 1–8, wheat; 9–40, corn.
1902. Clover.
1903. Clover.
1904. 1–16, cabbage; 17–40, corn.
1905. Soy beans.
1906. Potatoes.

The results last year with the soy bean seemed rather inconclusive, on account of the number of variations due to exceptional conditions not necessarily connected with the varying use of potash salts. In brief, it may be stated that the plots to which kainit was applied gave the smallest average crops in the field, the yield being less even than on the no-potash plots. Carbonate of potash gave the highest average yield, followed closely by high-grade sulfate and silicate, while the yields on nitrate, muriate and low-grade sulfate were not much inferior.

The crop of the past season was potatoes. The variety grown was the Green Mountain, the seed having been purchased in Maine. One accidental variation must here be recorded, viz., that the quantity of Green Mountain seed proved to be slightly less than was needed, so that it was necessary to use another variety, Carmen No. 3, also from Maine. on one of the plots (40). The seed potatoes were treated with formalin at the rate of 1 pint to 15 gallons of water in the usual way on May 7. The field was plowed on May 8. On May 10, 2,427 pounds of freshly slaked lime were applied. This was harrowed in on May 11. On May 12, fertilizers were applied and harrowed in on the same day. On the same date, also, one-half the plots, four series, 1-20, were planted. On May 14, the balance of the field was planted. The crop was carefully cared for throughout the entire season. The vines were repeatedly sprayed with Bordeaux mixture, and carefully protected from bugs by the customary measures. Early in the season the vines on the no-potash plots showed a marked inferiority in growth. They were characterized by a dark, bluish-green color. The vines on the plots receiving chlorides in any form showed a distinctly lighter shade of green (pea green) than those manured with other potash salts. The vines on the silicate of potash plots were very dark in color, and somewhat resembled in general appearance, though much larger in growth, the vines on the no-potash plots.

The yields per plot and the rates of yield per acre are shown in the following table: —

Plots.	Potash Salt.	Pounds per Plot.		Bushels per Acre.	
		Large.	Small.	Large.	Small.
1,	No potash,	305.25	106.50	203.50	71.00
2,	Kainit,	424.75	83.75	283.16	55.83
3,	High-grade sulfate,	428.50	74.50	285.66	49.66
4,	Low-grade sulfate,	407.00	65.00	271.33	43.33
5,	Muriate,	439.75	74.00	293.16	49.33
6,	Nitrate,	412.75	71.50	275.16	47.66
7,	Carbonate,	374.25	94.50	249.50	63.00
8,	Silicate,	362.25	63.75	241.50	42.50
9,	No potash,	280.25	45.00	186.83	30.00
10,	Kainit,	340.00	47.00	226.66	31.33
11,	High-grade sulfate,	351.00	49.00	234.00	32.66
12,	Low-grade sulfate,	360.25	47.25	240.66	31.50
13,	Muriate,	332.50	53.00	221.66	35.33
14,	Nitrate,	350.75	37.00	235.50	24.66
15,	Carbonate,	313.50	76.00	209.00	50.66
16,	Silicate,	337.75	58.50	225.16	39.00
17,	No potash,	172.50	44.50	115.00	29.66
18,	Kainit,	231.25	33.25	154.16	22.66
19,	High-grade sulfate,	267.00	38.00	178.00	25.33
20,	Low-grade sulfate,	247.50	36.75	166.66	24.50
21,	Muriate,	269.50	40.00	179.66	26.66
22,	Nitrate,	241.50	55.50	161.00	37.00

Plots.	Potash Salt.	Pounds per Plot.		Bushels per Acre.	
		Large.	Small.	Large.	Small.
23,	Carbonate,	252.25	81.25	168.66	54.16
24,	Silicate,	235.25	61.25	156.83	40.33
25,	No potash,	135.50	50.50	90.33	33.66
26,	Kainit,	264.75	29.00	176.50	19.33
27,	High-grade sulfate,	278.75	35.50	185.83	23.66
28,	Low-grade sulfate,	330.25	36.25	220.16	24.16
29,	Muriate,	320.25	47.50	213.50	31.66
30,	Nitrate,	285.75	58.75	190.50	39.16
31,	Carbonate,	335.00	76.50	223.33	51.00
32,	Silicate,	254.25	74.25	167.83	49.50
33,	No potash,	167.00	46.00	111.33	30.66
34,	Kainit,	292.00	39.00	194.66	26.00
35,	High-grade sulfate,	307.25	41.00	204.83	27.33
36,	Low-grade sulfate,	310.00	44.00	206.66	29.33
37,	Muriate,	315.75	73.00	210.50	48.66
38,	Nitrate,	321.75	49.00	214.50	32.66
39,	Carbonate,	298.25	70.00	198.83	46.66
40,	Silicate,	312.00	59.00	208.00	39.33

The average yields under the varying fertilizer treatments are as follows: —

Potatoes. — Average Yields per Acre (Bushels).

Potash Salt.	Large.	Small.
No potash (plots 1, 9, 17, 25, 33),	141.40	39.00
Kainit (plots 2, 10, 18, 26, 34),	207.03	31.03
High-grade sulfate (plots 3, 11, 19, 27, 35),	217.66	31.73
Low-grade sulfate (plots 4, 12, 20, 28, 36),	221.09	30.56
Muriate (plots 5, 13, 21, 29, 37),	223.70	38.33
Nitrate (plots 6, 14, 22, 30, 38),	215.33	36.23
Carbonate (plots 7, 15, 23, 31, 39),	209.86	53.10
Silicate (plots 8, 16, 24, 32, 40),	199.86	42.13

It will be noticed that the no-potash plots on the average give a yield much inferior to that produced on the plots receiving potash. The best average yield is produced by the muriate, but the differences between the yield on this potash salt and the average yield produced by the low-grade and high-grade sulfate and the nitrate are small. Carbonate ranks next, followed by kainit and silicate. The past season (June 1 to August 15) was characterized by rainfall considerably below the average. Previous experiments have shown that in such seasons muriate of potash can usually be depended upon to give crops equal to those produced where the sulfates are used. Lime, moreover, is known to offset in a measure the unfavorable results consequent upon continued use of muriate; and the entire field, as stated, was limed this season.

We are unable at this time to make a report in relation to the quality of the tubers produced on the different fertilizers, but the different lots have been carefully sampled, and such a report will be made later.

The Effect of the Liming. — Attention is called to the fact that in using lime immediately preceding the potato crop we departed from the usually accepted rule. Such use of lime is not regarded as desirable on account of the chances that the immediately following crop of potatoes will be scabby. This result was noted upon a portion of the plots in this field, principally 1 to 8. The amount of scab, however, was not on the whole serious.

The Relation of the Potash to Potato Blight. — As has been stated in the description of the general care given the crop, the potatoes in this field were repeatedly and carefully sprayed with Bordeaux mixture. The dates of the successive applications were as follows: June 27, July 7, August 2–3, August 10. Early in August it was noticed that the leaves of all the no-potash potato plants were beginning to blight, while the foliage on all the plots to which potash has been annually applied still appeared to be practically unaffected. The blight made rapid progress on each of the five no-potash plots, while the foliage of the vines upon all the other plots for the most part ripened normally. Practically all the leaves on the no-potash plots were dead by the end of August, at which date there was still considerable living foliage on the other plots. There was no decay of the tubers, however, on any of the plots; but the marked inferiority in yield on the no-potash plots was no doubt in considerable measure due to the relatively early death of the foliage.

No explanation can be offered at this time for the observed phenomena. Earlier observers, among them Dr. Goessmann and Professor Maynard, have held that a liberal supply of potash has in some cases exercised a marked influence in enabling the foliage of fruits to resist fungous diseases. Some European investigators have attributed a similar effect to potash in connection with potato diseases. This matter should evidently receive further and most careful study, for, if potato blight can be in a measure controlled through more liberal use of potash salts, this will afford a comparatively easy method of reducing the amount of injury due to the fungi attacking the foliage of this important crop.

IV. — NORTH CORN ACRE. — SPECIAL FERTILIZER *v.* FERTILIZER RICHER IN POTASH.

This experiment was begun in 1891. It occupies an acre of ground, divided into four equal plots. Plots 3 and 4 were sown to millet during the first two years of the experiment, but with this exception their treatment has been the same as that of plots 1 and 2, 3 being a duplicate of 1, and 4 a duplicate of 2, both as regards fertilizer application and crops produced. During the period under consideration the entire area with the exception noted for plots 3 and 4, has been in corn, with the exception of three two-year periods, 1897 and 1898, 1899 and 1900, and the past two years, during which periods the land has been in mixed grass and clover. The method of seeding in every instance has been by sowing in the corn of the year preceding the first of each of the three two-year periods during which hay has been the crop.

The object in this experiment is to test the question whether the special corn fertilizers offered in our markets are of such composition as seems to be best suited for the production of corn and mixed hay in rotation. Plots 1 and 3 have yearly received an application of fertilizers (a home mixture) furnishing per acre the same amount of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer having the composition of the average of the special corn fertilizers analyzed at this station. This average changes but little from year to year, and in 1899, since which date we have made no change in the kinds and amounts of fertilizers used, it was as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The averages for the past year have been: nitrogen, 2.61 per cent.; phosphoric acid, 11.55 per cent.; and potash, 4 per cent.

The fertilizers which have been used on plots 2 and 4 are substantially the same in amount and kind as were recommended for corn in Bulletin No. 58 (Hatch). The essential difference in the fertilizer mixtures under comparison is that the mixture used on plots 2 and 4 is richer in potash and much poorer in phosphoric acid than the mixture representing the average market corn fertilizers. The difference in the application of the fertilizer elements is shown in the following table: —

Fertilizer Elements applied annually.

PLOTS.	RATES PER ACRE (POUNDS).		
	N	P_2O_5	K_2O
Plots 1 and 3,	42.6	180	77.4
Plots 2 and 4,	47.0	50	125.0

The fertilizer materials applied to the several plots annually are shown below: —

FERTILIZERS USED.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	–
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Muriate of potash,	37.5	62.5

This field was limed in 1900 at the rate of 1 ton to the acre.

The crop of the past season was mixed grass and clover, the present being the second year for this seeding. The rates of yield per acre on the several plots and the averages for the two systems of manuring are shown by the following tables: —

Yields per Acre (Pounds).

PLOTS.	Hay.	Rowen.
Plot 1 (lesser potash),	2,600	1,680
Plot 2 (richer in potash),	2,320	1,480
Plot 3 (lesser potash),	2,980	1,300
Plot 4 (richer in potash),	2,400	2,020

Average Yields per Acre (Pounds).

PLOTS.	Hay.	Rowen.
Plots 1 and 3 (lesser potash),	2,790	1,490
Plots 2 and 4 (richer in potash),	2,360	1,750

It will be noticed that the combination of fertilizers representing the special corn fertilizer gives an average yield of hay at the rate of 430 pounds per acre heavier than that produced where the combination of fertilizer materials richer in potash was used. On the other hand the latter combination of fertilizer materials gives a yield of rowen averaging 260 pounds per acre greater than the special corn fertilizer. The total crops, then, produced under the two systems of fertilizing, are not far from equal for the past year.

Since this experiment was begun, this land has produced on plots 1 and 2, ten corn crops; on plots 3 and 4, eight corn crops. The average yields per plot and the averages for the two systems of fertilizing are shown in the following tables: —

Average Yields of Corn per Acre.

Plots.	Corn (Bushels).	Stover (Pounds).
Ten Years.		
Plot 1 (lesser potash),	56.77	4,596
Plot 2 (richer in potash),	51.98	4,640
Eight Years.		
Plot 3 (lesser potash),	55.18	4,371
Plot 4 (richer in potash),	52.99	4,590

Average Yields per Acre on the Two Systems of Fertilizing.

Plots.	Corn (Bushels).	Stover (Pounds).
Plots 1 and 3 (lesser potash),	55.98	4,484
Plots 2 and 4 (richer in potash),	52.48	4,615

During the period of this experiment the entire field has produced six crops each of hay and rowen. The averages for each plot and the averages for the two systems of fertilizing are shown in the following tables: —

Average Yields per Acre of Hay and Rowen, Six Years (Pounds).

Plots.	Hay.	Rowen.
Plot 1 (lesser potash),	3,655	1,100
Plot 2 (richer in potash),	3,785	1,176
Plot 3 (lesser potash),	3,459	885
Plot 4 (richer in potash),	3,607	1,203

Average Yields per Acre on the Two Systems of Fertilizing, Six Years (Pounds).

Plots.	Hay.	Rowen.
Plots 1 and 3 (lesser potash),	3,557	993
Plots 2 and 4 (richer in potash),	3,696	1,152

It will be noticed that the average crop of corn has been somewhat heavier, while the average crop of hay is slightly less, on the combination of materials representing the special corn fertilizer. The crops of corn stover and of rowen have been greater on the combination of materials furnishing more potash. This is in accordance with what is to be expected, as the potash is found almost invariably to favor a large proportion of clover in mixed mowings, and as it has been shown in the results of many experiments in this State that stover is increased in larger proportion through application of potash than is the grain.[1]

At the prices which have prevailed during the period of the experiment, the cost per acre of the fertilizers used on plots 2 and 4 has averaged about $5 less than the cost of the materials used on plots 1 and 3. Taking the crops as a whole, they have been substantially equal under the two systems of fertilizing; and the advantage, therefore, is clearly with the fertilizer combination richer in potash, unless it can be shown that the condition of the soil upon plots 2 and 4 is now inferior to that of the soil on plots 1 and 3. Such inferiority is not indicated by the present relative yields. Neither does a study of the income and outgo from the soil of fertilizer elements upon the several plots point in that direction. Calculations made at the close of 1905 to determine the fertilizer ingredients supplied and removed from the several plots gave the following results: —

PLOTS.	FERTILIZER INGREDIENTS.					
	SUPPLIED.			REMOVED.		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Plot 1 (lesser potash), ...	135.10	537.94	216.00	331.08	117.74	228.46
Plot 2 (richer in potash), . . .	117.55	217.63	470.00	322.44	114.32	229.79
Plot 3 (lesser potash), ...	135.10	537.94	216.00	259.52	93.37	180.26
Plot 4 (richer in potash), . . .	117.55	217.63	470.00	307.38	109.97	234.27

A study of the figures of the above table indicates that on every plot a much larger quantity of nitrogen has been removed from the soil than has been supplied in the fertilizers used. The large excess of nitrogen removed can be accounted for only as a result of the frequent introduction of clover in the rotation.

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[1] Bulletin No. 9 and Bulletin No. 14, Hatch Experiment Station.

It will be noticed that on plots 1 and 3 phosphoric acid has been applied in the fertilizers used in quantity on the average more than five times greater than the quantity removed. Even on plots 2 and 4 phosphoric acid has been supplied in quantity practically double that removed.

Potash on one of the plots (1 and 3) has been supplied in slightly larger quantity than removed, while on the other plot the quantity removed is slightly in excess of the quantity supplied.

On the average, the condition of the soil as regards this element on plots 1 and 3 cannot be materially different from what it was at the beginning of the experiment. On plots 2 and 4, on the other hand, potash has been supplied in quantity a little more than double that removed.

V. — South Corn Acre. — Manure Alone *v.* Manure and Potash.

The object in view in this experiment is to compare the crop-producing capacity of manure alone applied in fairly liberal amounts with a combination of a lesser amount of manure and a moderate quantity of a potash salt. An acre of land is used in the experiment. It is divided into four plots, of one-quarter acre each. Two of the plots (1 and 3) have received applications of manure only; the other two plots (2 and 4) have been fertilized by applications of lesser amounts of manure, together with a potash salt.

This experiment was begun in 1891. The crop for the first six years was corn. Corn was raised also in 1899 and 1900, and in 1903 and 1904. The field has been put into mixed grass and clover three times, being seeded in the summer preceding the first year of cutting in the corn crop. Each time that the land has been seeded it has been cut twice annually for two years. The sod has then been broken in the fall for the corn crop of the following year. The years when the field has been in mowing are 1898 and 1899, 1901 and 1902, and 1905 and 1906.

Manure has been applied to plots 1 and 3 every year, at the rate of 6 cords per acre, with the following exceptions. No manure was applied in 1897, 1902 and 1905, and in 1898 the amount applied was at the rate of 4 cords per acre. The reason for the omission of manure in the years mentioned and for the smaller amount in 1898 was that experience indicated that its application would cause the grass and clover to lodge badly.

Manure has been applied to plots 2 and 4 as follows: in 1891 and 1892, at the rate of 3 cords per acre; in 1898, at the rate of 2 cords per acre; while in 1897, 1902 and 1905 no manure was applied. In all other years the application has been at the rate of 4 cords per acre. Potash has been applied to plots 2 and 4 at the rate of 160 pounds per acre of high-grade sulfate annually, except in the years when no manure was applied. In these years the potash also was withheld.

The entire field was limed in 1900, at the rate of 1 ton per acre. The manure applied has been that made by well-fed milch cows, and carefully preserved. It has usually weighed about 3 tons per cord. Both manure and fertilizer have been applied broadcast after plowing, and harrowed in.

The crop of the past season was mixed grass and clover, this being the second year, as above indicated. The manure was applied with a spreader on May 2. The high-grade sulfate was applied broadcast by hand, and this year, by mistake, it was applied to plots 1 and 3 as well as to plots 2 and 4.

The following tables show the rates of yield on the several plots and the averages under the two systems of manuring: —

Yields Per Acre, 1906 (Pounds).

Plots.	Hay.	Rowen.
Plot 1 (manure alone),	3,880	2,640
Plot 2 (manure and potash),	3,200	2,384
Plot 3 (manure alone),	3,592	2,396
Plot 4 (manure and potash),	3,180	2,416

Average Yields per Acre (Pounds).

Plots.	Hay.	Rowen.
Plots 1 and 3 (manure alone),	3,736	2,518
Plots 2 and 4 (manure and potash),	3,190	2,400

It will be noticed that the hay crop on the combination of manure and potash is less than on the larger quantity of manure alone in both cases, the average difference being at the rate of 646 pounds per acre. The rowen crops are more nearly equal, the average difference amounting to only 118 pounds per acre in favor of the larger application of manure. The heavier application of manure means, of course, a larger application of nitrogen. It is not surprising, therefore, that the first crop, which includes a considerable proportion of timothy and redtop, is heavier where the manure is most largely used. The rowen crop is made up in much larger proportion of clover, and the proportion of clover is greater where the lesser quantity of manure and the potash salt are applied. Estimating the manure to cost on the land $5 per cord and the high-grade sulfate of potash at the market rates, the usual annual difference in cost of materials applied has amounted to about $6 to $6.50 per acre, the lesser amount of manure and potash costing about that amount less than the larger application of manure.

This experiment has now continued sixteen years. During this time ten corn crops have been raised. The average yields per plot and the averages for the two systems of manuring are shown in the following tables: —

Average Yields per Acre.

Plots.	Corn (Bushels).	Stover (Pounds).
Plot 1 (manure alone),	62.32	4,929
Plot 2 (manure and potash),	58.48	4,579
Plot 3 (manure alone),	61.29	4,292
Plot 4 (manure and potash),	57 54	4,104

Average Yields per Acre on the Two Systems of Manuring, Ten Crops.

Plots.	Corn (Bushels).	Stover (Pounds).
Plots 1 and 3 (manure alone), ...	61.81	4,611
Plots 2 and 4 (manure and potash), ...	58.01	4,342

It will be noticed that the average yield on plots 2 and 4 (lesser manure and potash) has been at the rate of about 3.8 bushels per acre less than on the larger quantity of manure alone.

During six years the experimental acre has been in mixed grass and clover. The following tables show the average results per plot and the averages for the two systems of manuring: —

Average Yields per Acre of Hay Crop, Six Years (Pounds).

Plots.	Hay.	Rowen.
Plot 1 (manure alone), ...	5,197	2,569
Plot 2 (manure and potash), ...	4,370	2,103
Plot 3 (manure alone), ...	4,970	2,546
Plot 4 (manure and potash), ...	4,923	2,415

Average Yields per Acre on the Two Systems of Manuring, Six Years (Pounds).

Plots.	Hay.	Rowen.
Plots 1 and 3 (manure alone), ...	5,084	2,558
Plots 2 and 4 (manure and potash), ...	4,647	2,259

It will be noticed that the average difference against the lesser quantity of manure and potash amounts to a little more than 400 pounds of hay and slightly less than 300 pounds of rowen per acre annually.

The differences indicated by the averages shown in the above tables, whether for corn or hay, are not sufficient to offset the greater cost of the heavier application of manure.

At the end of last year, calculations based in part upon analyses, and in part upon average figures for the composition of the crops raised, gave results presented in the following tables for the totals of plant food applied and removed in the several plots: —

PLOTS.	FERTILIZER INGREDIENTS.					
	SUPPLIED.			REMOVED.		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Plot 1 (manure alone), ...	425.41	330.69	511.51	394.07	138.74	282.60
Plot 2 (manure and potash), . .	291.09	229.98	543.68	361.22	127.91	256.64
Plot 3 (manure alone), ...	449.96	330.94	500.76	373.34	132.10	262.21
Plot 4 (manure and potash), . .	281.10	233.37	549.56	355.02	126.26	250.82

It will be noticed that on plots 1 and 3 the amounts of nitrogen applied in the manure show a moderate excess above the amount removed in the crops. On the other hand, the application of nitrogen to plots 2 and 4 (lesser manure and potash) is materially less than the amount removed. This result may have been rendered possible in one of two ways: first, the soil on these plots may have been depleted in part of its original store of nitrogen; second, the excess may have been taken from the air by the clover in the mixed hay crops grown during six of the sixteen years. As these plots show no indication of declining fertility, but, on the contrary, appear on the whole to be improving from year to year, the latter is with little doubt the correct explanation.

It will be noticed that under both systems of manuring we have applied phosphoric acid and potash in large excess above the amounts removed. In the case of plots 1 and 3, phosphoric acid has been applied in approximately two and one-half times the quantity removed; potash, in rather less than twice the quantity removed. In the case of plots 2 and 4, phosphoric acid has been applied in considerably less than twice the quantities removed; potash, in rather more than twice the quantities removed. In view of the fact that neither phosphoric acid nor potash is supposed to be lost to the soil to any considerable extent by leaching, the condition of the soil on all the plots as regards the stock of phosphoric acid and potash in available form must now be considerably better than at the beginning of the experiment; and there can be little doubt that a lesser application of these fertilizer elements in the immediate future will prove sufficient to give satisfactory crops.

VI. — Comparison of Phosphates on the Basis of Equal Application of Phosphoric Acid.

The past season is the tenth of this experiment, the object of which is to determine, as measured by crop production, the relative availability of different materials which may be used as sources of phosphoric acid. All these materials have from the first been applied in such quantities as to furnish phosphoric acid at the rate of 96 pounds per acre in the case of each of the materials under comparison. The field comprises thirteen plots, each containing one-eighth of an acre. Three of the plots have received no phosphoric acid since the experiment began. One of these is located at either end of the field, the third in the middle. The phosphates under comparison are the following: apatite (fine ground), South Carolina rock phosphate (fine ground), Florida soft phosphate, basic slag meal, Tennessee rock phosphate (fine ground), dissolved bone black, raw bone meal, dissolved bone meal, steamed bone meal and acid phosphate. Materials supplying nitrogen and potash liberally are applied to each of the plots annually, and in such quantities as to furnish nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. In the case of a few crops requiring especially high manuring (onions and cabbages), a supplementary application of quick-acting nitrogen fertilizers has been made to all plots alike. Owing to the impossibility of procuring the material, no apatite was applied to plot 2 during the past season. The crops which have been grown in the field during the progress of the experiment are as follows: corn, cabbages, corn, in 1900 two crops, — oats and Hungarian grass (both for hay), onions, onions, cabbages, and mixed grass and clover. The field was seeded in the spring of 1905 without a nurse crop. It was cut twice during the season, but the product, largely mixed with weeds, was not weighed.

During the past season the field has been cut twice and the product made into hay. The following table gives the yield per plot, the rates of yield per acre, and the gain or loss as compared with the no-phosphate plots, both for the hay and rowen: —

Plots.	Fertilizers used.	Yield per Plot (Pounds).		Yield per Acre (Pounds).		Gain or Loss (Pounds).	
		Hay.	Rowen.	Hay.	Rowen.	Hay.	Rowen.
Plot 1, .	No phosphate, . . .	825	225	6,600	1,800	-	-
Plot 2, .	Apatite, ...	940	215	7,520	1,720	800	—147
Plot 3, .	South Carolina rock phosphate.	930	202	7,440	1,616	720	—251
Plot 4, .	Florida soft phosphate, .	950	188	7,600	1,504	880	—363
Plot 5, .	Phosphatic slag, . .	950	200	7,600	1,600	880	—267
Plot 6, .	Tennessee phosphate, .	890	203	7,120	1,624	400	—243
Plot 7, .	No phosphate, . . .	875	275	7,000	2,200	-	-
Plot 8, .	Dissolved bone black, .	870	280	6,960	2,240	240	+373
Plot 9, .	Raw bone, ...	890	250	7,120	2,000	400	+133
Plot 10, .	Dissolved bone meal, .	940	319	7,520	2,552	800	+685
Plot 11, .	Steamed bone meal, . .	890	283	7,120	2,264	400	+397
Plot 12, .	Acid phosphate, . .	885	290	7,080	2,320	360	+453
Plot 13, .	No phosphate, . . .	820	200	6,560	1,600	-	-

It will be noticed that both the first and second crops of hay were heavy, the first especially so. This crop had lodged considerably before it could be cut, and there is little doubt that the possible increase due to the fertilizers was somewhat diminished through the check in growth consequent upon the badly lodged condition. We do not find the application of the phosphates to have apparently influenced the yield either of hay or rowen to a very large extent. The results are in harmony with previous observations upon our soils, which have indicated them to require relatively small applications of phosphates for all crops except those belonging to the Cruciferæ, such as cabbages and turnips. In 1903, when this entire field was planted to cabbages, the yields wherever phosphates were annually applied greatly exceeded the average yield on the no-phosphate plots. The range on the several phosphate plots was from about two to five times the average product of the no-phosphate plots. This year, with a mixed crop, grass and clover, representing Gramineæ and Leguminosæ, the largest increase on any phosphate is only about 17 per cent. In other words, when cabbages were the crop, the increase was in some instances as great as 500 per cent., or nearly thirty times as great as this year.

VII. — Soil Tests.

Two soil tests have been carried out during the past year, both in continuation of previous tests upon the same fields. In these tests fertilizers have been applied in accordance with the co-operative plan for soil tests. Each plot annually receives an application of the same kind or kinds of fertilizers, and usually in the same amounts for each of the plots from year to year. Particular attention is called to the fact that this system of fertilization is not expected to secure the production of heavy crops. It does throw important light upon the specific effects of the different leading elements of plant food by themselves and in combination on the crops which are grown in succeeding years. Every fertilizer used, whether applied by itself or in connection with one or both of the other fertilizer materials, is always applied in the same quantities; and both fertilizers and manure, when the latter is introduced for purposes of comparison, are always applied broadcast after plowing, and harrowed in when a hoed crop is to be grown. When mixed hay is the crop the materials are applied broadcast, and must of course be left on the surface. The kinds of fertilizers and the rates per acre are as follows: —

Nitrate of soda, 160 pounds, furnishing nitrogen.
Dissolved bone black, 320 pounds, furnishing phosphoric acid.
Muriate of potash, 160 pounds, furnishing potash.
Land plaster, 400 pounds.
Lime, 800 pounds.
Manure, 5 cords.

The germination of the soy beans on the north acre was very irregular. The stand of plants as a consequence was so uneven that the results do not indicate with any clearness the effect of the different fertilizers. The figures will not, therefore, be reported in detail. The results, however, clearly indicated the beneficial results which have followed the use of lime in connection with the other fertilizers.

Soil Test with Corn (South Acre). — This acre has been used in soil tests for eighteen years, beginning in 1889. The field has been limed twice during this period, each time at the rate of 1 ton to the acre. The lime was applied broadcast after plowing, and harrowed in. These applications of lime were made respectively in 1899 and in 1904.

The crops for successive years have been as follows: corn, corn, oats, grass and clover, grass and clover, corn (followed by mustard as a catch crop), rye, soy beans, white mustard, corn, corn, grass and clover, grass and clover, corn, corn, corn, grass and clover, grass and clover. Since 1899 this field has, therefore, borne eight corn crops. Three times it has been put into mixed grass and clover, each time for two years. The past season is the second of the third two-year period. The season has been a fairly favorable one for grass, although, as the soil of this field is inclined to be light, there can be no doubt that a somewhat heavier yield would have been obtained had the rainfall been larger. The following table shows the fertilizers used on the several plots, the rates of yield and the gain or loss per acre, compared with the nothing plots: —

Grass and Clover. — South Acre Soil Test, 1906.

Plots.	Fertilizers used.	Yield per Acre (Pounds).		Gain or Loss per Acre, compared with Nothing Plots.	
		Hay.	Rowen.	Hay.	Rowen.
Plot 1, .	Nitrate of soda, ...	1,400	520	+490.0	+220.00
Plot 2, .	Dissolved bone black, . . .	760	295	—150.0	—5.00
Plot 3, .	Nothing, ...	910	300	-	-
Plot 4, .	Muriate of potash, ...	690	440	—136.7	+131.70
Plot 5, .	Lime, ...	890	260	+146.7	—56.70
Plot 6, .	Nothing, ...	660	325	-	-
Plot 7, .	Manure, ...	2,940	2,670	+2,226.7	+2,323.30
Plot 8, .	Nitrate of soda and dissolved bone black.	2,200	520	+1,433.3	+151.70
Plot 9, .	Nothing, ...	820	390	-	-
Plot 10, .	Nitrate of soda and muriate of potash.	2,400	470	+1,536.7	+73.33
Plot 11, .	Dissolved bone black and muriate of potash.	1,790	1,220	+883.3	+816.70
Plot 12, .	Nothing, ...	950	410	-	-
Plot 13, .	Plaster, ...	640	320	—310.0	—90.00
Plot 14, .	Nitrate of soda, dissolved bone black and muriate of potash.	3,000	1,100	+2,050.0	+1,690.00

It will be noticed that the yield on all the nothing plots is extremely small, — considerably less than one-half ton per acre. It will be noticed, further, that neither lime nor plaster used by itself produced an increase; indeed, the yield on both is lower than the average yield of the nothing plots. Nitrate of soda by itself produces a very small increase; in combination with either of the other fertilizer elements the increase is much larger, but it is best, as would naturally be expected, in combination with both the other fertilizer elements. It will be noted that the use in combination of dissolved bone black and muriate of potash gives a considerable increase in the crop. This increase shows itself almost as plainly in the rowen as in the first crop, as a consequence, of course, of the relatively large proportion of clover which follows continuous use of materials supplying phosphoric acid and potash without nitrogen. The average results obtained in the six years during which this field has been in hay will be of interest. They are shown in the following table: —

Average Increases in Six Hay and Rowen Crops.

	Averages of Nothings.	Nitrate.	Bone Black.	Muriate.	Lime.	Manure.
Hay, ...	853.8	722.5	—100.0	152.6	120.0	2,579.2
Rowen, ...	604.4	743.3	+52.5	632.0	108.8	2,357.2
Totals, . . .	1,458.1	1,465.8	—47.5	784.5	228.8	4,936.4

Average Increases in Six Hay and Rowen Crops — Concluded.

	Nitrate and Bone Black.	Nitrate and Muriate.	Bone Black and Muriate.	Plaster.	Nitrate, Bone Black and Muriate.
Hay, ...	1,183.3	1,474.2	1,113.3	—275.5	2,092.5
Rowen, ...	430.3	565.5	952.8	—221.8	878.3
Totals, . . .	1,513.6	2,039.7	2,066.2	—497.2	2,970.8

This table affords conclusive evidence that hay can be grown at a profit on fertilizers alone, although naturally the increases produced by the very moderate applications of fertilizers used in this experiment are not equal to those produced by the annual application of manure. The latter, however, at $5 per cord on the land costs annually at the rate of $25 per acre; the combination of dissolved bone black and muriate of potash costs annually at the rate of about $6 per acre; while the annual application of all three fertilizer elements costs at the rate of about $10 to $11 per acre.

VIII. — Experiment in Manuring Grass Land.

The plan of this experiment, which was begun in 1893, is fully outlined in the sixteenth annual report. From that report I quote: —

> In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about 9 acres. It is divided into three approximately equal plots. The plan is to apply to each plot one year barnyard manure, the next year wood ashes, and the third year, fine-ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds; and muriate of potash, 200 pounds, per acre. The manure is always applied in the fall; ashes and the bone and potash in early spring.

The past season, which showed a considerable deficiency in rainfall during the months when a liberal supply of moisture is highly important for the hay crop, was unfavorable to large yields, and the product of the past season falls considerably below the average product for the period of the experiment. The yields of hay and rowen and the total yields for each system of manuring were at the following rates per acre: —

Fertilizers used.	Hay (Pounds).	Rowen (Pounds).	Total (Pounds).
Barnyard manure, ...	2,892	1,063	3,955
Bone and potash, ...	2,420	1,396	3,816
Wood ashes, ...	2,932	1,240	4,172

The average for the entire area this year was 4,002 pounds. The average yield of the entire area from 1893 to 1905, inclusive, was 6,572 pounds. Including the crop of the past season, the average for the entire period, 1893 to the present time, is 6,389 pounds. The average yields to date under the different systems of top-dressing have been as follows: —

	Pounds per Acre.
When top-dressed with manure,	6,658
When top-dressed with wood ashes,	6,059
When top-dressed with bone and potash,	6,331

IX. — Experiment in the Application of Manure.

This experiment was planned to be continued through a series of years, with a view to throwing light upon the question as to the best method of handling farm manures. The field in use has an area of a little less than three acres, and slopes moderately to the west. It had been divided into five plots a number of years previous to the beginning of this experiment, for the comparison of different fertilizers. Each of these five plots was subdivided into two sub-plots. To one of these sub-plots in each of the five pairs the manure is applied during the winter, being spread upon the surface as it is hauled to the field; to the other sub-plot in each of the five pairs the manure as it is hauled is put into a large, compact heap. The manure used is carefully preserved, from well-fed dairy cows on four of the pairs of plots (1, 2, 3 and 4), and purchased stable manure from horses on one pair of plots (5). The experiment is so managed that all the manure is hauled for a single pair of plots at one time, usually during a single day, or at most within two days. To insure even quality of the manure on the two sub-plots, loads are placed alternately on the north half, where it is spread as hauled; and on the south half, where, as has been stated, it is put into a large heap. The land has usually been plowed late in the fall. The manure has usually been applied to the two sub-plots 1 early in the winter; to the sub-plots 2, 3 and 4 respectively at intervals each about one month later than the preceding. The manure which is placed in the heaps remains there until it is time to prepare the soil for planting in the spring. It is then spread, and as soon as convenient the entire area, including both the winter and the spring applications, is plowed. It is estimated that the double handling of the manure required in the case of that portion which is applied in the spring costs at the rate of $4.80 per acre more than the single handling where the manure is spread when hauled during the winter.

The experiment was begun in 1899; the present season, therefore, is the eighth during which the experiment has been continued. The crop of the past season was corn. Fourteen different varieties of seed were used. The different plots, however, were so planted that each contained equal areas of each variety. The fact that a number of varieties was used is mentioned only because it is a partial explanation of the fact that the yield in this field is considerably lower than is usual in this vicinity on well-manured land. This inferiority in yield was due to the fact that many of the varieties which we had been asked to test by the United States Department of Agriculture proved comparatively worthless. The rates of yield per acre and the relative standing of the several plots are shown in the following tables: —

Corn and Stover. — Actual Yields (Rates per Acre).

PLOTS.	NORTH HALF, WINTER APPLICATION.			SOUTH HALF, SPRING APPLICATION.		
	Stover (Pounds).	Hard Corn (Bushels).	Soft Corn (Bushels).	Stover (Pounds).	Hard Corn (Bushels).	Soft Corn (Bushels).
Plot 1, ...	3,741	36.43	5.86	3,961	38.61	5.65
Plot 2, ...	3,414	30.50	4.64	3,893	37.48	4.99
Plot 3, ...	3,563	35.72	5.34	3,847	38.73	5.05
Plot 4, ...	3,171	32.13	5.01	3,143	29.95	5.61
Plot 5, ...	3,401	31.22	4.32	3,457	31.91	4.13

Corn and Stover. — Relative Yields (Per Cent.).

PLOTS.	NORTH HALF, WINTER APPLICATION.		SOUTH HALF, SPRING APPLICATION.	
	Stover.	Hard Corn.	Stover.	Hard Corn.
Plot 1, ...	100	100	105.7	104.7
Plot 2, ...	100	100	114.0	122.9
Plot 3, ...	100	100	107.8	108.4
Plot 4, ...	100	100	99.1	93.2
Plot 5, ...	100	100	101.6	102.2

It will be noticed that in every instance the spring application of manure has given a larger yield both of stover and of hard corn than the winter application, except on plot 4. This exception, in our judgment, is due to the fact that during the early part of the season it was comparatively rainy, and a part of the area on the south half of plot 4 was over wet, so that the seed germinated imperfectly. The results of this year, then, although naturally not showing precise numerical agreement, are in entire accord with those obtained in 1905. During the entire period that the experiment has continued the results as a rule have been similar.

It has been noticed that the degree of superiority of the crops on the sub-plots where the manure was spread in the spring has varied with the character of the preceding winter. There is evidently some loss in manurial value through the exposure of the manure throughout the winter, and this loss is probably for the most part due to wash over the frozen ground during the winter or early spring. It has been found that in a season following a cold winter, where snow has covered and protected the manure during practically all the time, and where there has been a minimum of water flowing over the surface, the winter-applied manure has given results closely approaching those upon the manure applied in the spring. It is manifestly impossible to foresee the character of the approaching winter months, and so there must always be a degree of uncertainty as to results. Taken as a whole, however, the differences obtained in our experiments in favor of spring application have been relatively small, and during a large proportion of the time insufficient in value to cover the extra cost of the double handling.

In estimating the significance of our results, it should be kept in mind that the field on which these experiments have been tried has a considerable slope. It is, therefore, of such a character as is favorable to considerable waste through surface wash, whenever the conditions are such as to make such wash possible. It is not believed that on land which is substantially level, and which can be fall plowed, the amount of waste due to the exposure incident to surface application in winter will be sufficiently great to make it good farm economy to give the manure the double handling involved in the spring application. If the storage for manure is sufficient, so that it can be safely held where made until spring, application at that season will undoubtedly be safest on most of our New England farms, where the surfaces of the fields are usually far from level. With level fields, on the other hand, application of manure during the winter would seem to be the better farm practice.

X. — Nitrate of Soda for Rowen.

The station has been experimenting for a number of years, with a view to noting whether nitrate of soda applied soon after the first crop is cut will give a profitable increase in the rowen crop. The field in which most of our experiments have been tried was seeded to pure timothy in the fall of 1897. The crop is now considerably mixed with clover (mostly white), which has been gradually coming in. For the first crop we apply fertilizers at the following rates per acre: nitrate of soda, 150 pounds; muriate of potash, 200 pounds; fine-ground bone, 400 pounds. The total area of the field is a little more than three acres. The rate of yield of the first crop this year was 3,153 pounds per acre, which is considerably less than the average product since the field was seeded. For the purpose of the experiment with nitrate of soda, eight equal plots have been laid off, each containing almost exactly one-third of an acre. During the past six years alternate plots in this series of eight have annually received a top-dressing of nitrate of soda. For the past three years, in order that this may be more uniformly spread, we have mixed the nitrate of soda for each plot with such a quantity of basic slag meal as to constitute an application of the latter at the rate of 400 pounds per acre. To equalize conditions on the alternate plots to which no nitrate is applied, the slag meal is applied to all of these at the same rate. The application of fertilizers to the several plots and the rates of yield per acre are shown in the following table: —

Nitrate of Soda for Rowen.

Plots.	Fertilizers used (Rates per Acre).	Yield (Pounds).	Increase per Acre (Pounds).
Plot 1, .	Slag meal, 400 pounds, ...	1,535	–
Plot 2, .	Slag meal, 400 pounds; nitrate of soda, 150 pounds,	2,590	1,074
Plot 3, .	Slag meal, 400 pounds, ...	1,496	–
Plot 4, .	Slag meal, 400 pounds; nitrate of soda, 150 pounds,	2,148	592
Plot 5, .	Slag meal, 400 pounds, ...	1,615	–
Plot 6, .	Slag meal, 400 pounds; nitrate of soda, 200 pounds,	2,648	1,027
Plot 7, .	Slag meal, 400 pounds, ...	1,627	–
Plot 8, .	Slag meal, 400 pounds; nitrate of soda, 250 pounds,	3,614	1,987

The nitrate of soda has in every instance given a considerable increase, — more than enough in every instance to cover the cost of the nitrate applied. As was pointed out last year, however, it is not believed that the large increase on plot 8 is altogether due to the nitrate used, for evidently the moisture conditions on this plot are rather better than on plot 7, with which it is compared. Of the six trials of nitrate of soda for rowen which have been completed, three have shown increases sufficiently large to make the application profitable, while in the other trials the application was made at a loss. As is natural, the result of an application of nitrate for rowen varies widely with the season. When such an application is followed by a sufficient and well-distributed rainfall, it gives a very profitable increase in the crop; but when the weather succeeding the application is dry, the nitrate is relatively non-effective. It is of course impossible to foresee the nature of the weather which will follow the use of nitrate. It would appear, however, that there is at least an equal chance that a moderate application will give a good margin of profit. Close observation of the field in which this experiment has been tried indicates that where, owing to succeeding relatively dry weather, the nitrate proves ineffective for the immediately succeeding crop of rowen, it will, nevertheless, on this fairly compact loam be retained by the soil in sufficient quantity to favorably influence the hay crop of the following season. We have as yet, however, no figures that can be presented which demonstrate this fact.

XI. — Variety Test, Potatoes.

During the past season we have carried out the second year's trial with twenty-five varieties of potatoes. The seed used in making these trials was all of our own production, and was kept under similar conditions throughout the winter. The soil in which the varieties were planted is a medium loam, which was used for corn in 1905. It received a liberal application of commercial fertilizers. The varieties under trial, the area planted to each, the actual yields for each and the rate per acre are shown in the following table: —

Variety.	Area planted (Acres).	Yield per Plot (Pounds).		Yield per Acre (Bushels).	
		Large.	Small.	Large.	Small.
Good as Gold,	.0104	52.00	16.00	83.33	25.64
Early Quebec,	.0104	98.00	5.50	157.05	8.81
Chenango White,	.0104	126.75	7.50	203.13	11.91
Reliance,	.0104	108.75	15.00	174.28	24.04
Early Canada,	.0104	112.50	8.50	180.16	13.62
Great Divide,	.0104	82.50	11.50	132.21	18.43
Beauty of Hebron,	.0104	100.00	16.25	160.26	26.04
Clark's Pride,	.0104	84.50	18.00	135.32	28.85
Extra Early White Rose,	.0104	105.50	7.25	169.07	11.62
Banner,	.0104	66.75	2.00	106.97	3.21
Early Rose,	.0104	106.00	14.50	169.87	23.24
Vermont Gold Coin,	.0104	99.25	11.25	159.06	18.03
Climax,	.0104	127.00	17.00	203.52	27.24
Short Seasons,	.0104	59.25	5.00	94.95	8.01
Gorthsap,	.0104	119.00	11.75	190.71	18.83
Dewey,	.0052	59.50	4.00	190.70	12.84
Hammond's Wonderful,	.0052	63.25	6.00	202.72	19.26
Salzer's Sunlight,	.0052	35.50	5.00	113.78	16.01
Keller,	.0052	36.50	1.50	116.99	4.81
Uncle Gideon's Quick Lunch,	.0052	20.75	10.50	66.51	33.65
Noroton Beauty,	.0052	30.75	5.00	98.56	16.01
Nebraska,	.0052	48.00	4.25	153.85	13.62
Simmon's Model,	.0052	63.50	5.50	201.92	17.62
Harris' Snowball,	.0026	18.00	2.00	115.38	12.82
Mills' New Rose Beauty,	.0026	17.25	3.25	110.58	20.83

It will be seen that most of the varieties gave a fairly satisfactory yield. Four only gave a yield of merchantable tubers in excess of 200 bushels; these, in the order of their rank, were: Climax, Chenango White, Hammond's Wonderful and Simmon's Model. Four varieties gave a yield at the rate of less than 100 bushels of merchantable tubers per acre; these, in the order of their inferiority, were: Uncle Gideon's Quick Lunch, Good as Gold, Short Seasons and Noroton Beauty.

The seed of all the varieties was treated with formalin, and the product was free from scab. They were twice sprayed with Bordeaux mixture. The varieties showing blight earliest were Good as Gold, Uncle Gideon's Quick Lunch and Noroton Beauty. All the vines of these varieties were dead on August 14, on which date Salzer's Sunlight, Climax and Clark's Pride were beginning to show blight. The six varieties named were the only ones apparently much affected. Among these varieties, all except Climax gave a small yield, those earliest blighted being among the very poorest.

XII. — Poultry Experiments.

The poultry work of the past year has been a repetition of the feeding experiments of the preceding year. These experiments had indicated: first, that, provided fat is abundant in the ration, high protein content is not essential; second, that, if the fat content of the ration is low, a large proportion of protein in the feeds used appears to be much more essential; and third, that a large proportion of fiber in the ration used is unfavorable to a good egg product. The fowls used in the experiment this year, as last, were pullets of our own raising; and in comparing different food combinations, carefully matched flocks have been kept, as in former years, each in a house by itself, all the houses being of precisely similar dimensions and construction.

1. The fowls in houses Nos. 1 and 2 have been fed on rations characterized by high content both of ash and fat and low fiber. As wheat is relatively deficient in fat, the ration in which it is largely used received an addition of

corn oil. This is mixed with the grains in the mash in such quantities that the total amount of fat in the two food combinations under comparison is substantially the same for each. This experiment, therefore, in a general way affords opportunity to test the relative value for egg production of a ration relatively high in protein (the one containing a large proportion of wheat) with one relatively low in protein (containing a large proportion of corn). The nutritive ratio of the ration used in house No. 1, which may be denominated "the wheat ration," is narrow, — 1 to 4.57. The ration used in house No. 2, which may be called "the corn ration," has a relatively wide nutritive ratio, — 1 to about 6.5. The animal food used in both these rations was beef scraps. The following results were obtained. For the first period, January 25 to April 28, inclusive, the wheat ration produced eggs at the average rate of .48 per hen day; the corn ration, at the rate of .54 per hen day. For the second period, April 28 to September 5, inclusive, the wheat ration produced eggs at the average rate of .37 per hen day; the corn ration, at the rate of .39. In other words, 100 hens, if laying at the same rates, would have produced during the winter period 48 eggs per day on the wheat ration and 54 eggs per day on the corn ration; during the summer period, 37 eggs per day on the wheat ration and 39 eggs per day on the corn ration. The average food cost per egg produced was: for the wheat ration .96 cents, and for the corn ration .73 cents, for the first period; while for the second period the food cost per egg on the wheat ration was 1.01 cents and on the corn ration .82 cents. The gross cost of the food on the wheat ration varied from about .37 cents to .42 cents per day for each fowl, while on the corn ration the cost varied from .31 cents to .36 cents per day. The number of eggs on the corn ration, as will have been noted, was considerably more than on the other. The cost per egg was smaller and the daily cost per fowl was smaller. The results of the past year are in exact accord with those obtained in similar experiments in earlier years. Our egg production with these pens of fowls must be regarded as fairly satisfactory, and it seems impossible to doubt that corn judiciously used in combination with other foods has superior merits for egg production as compared with wheat.

2. The rations fed to the fowls in houses Nos. 3 and 4 were relatively high in ash and low in fiber. Milk albumen was the animal food used. This was selected on account of the low percentage of fat it contains, and the rations fed to the fowls in both of these houses were characterized by much lower fat contents than the rations fed to the fowls in houses Nos. 1 and 2. As in the experiment previously described, the fat content of the two rations used in houses Nos. 3 and 4 was equalized by the addition of corn oil to the one naturally lower in fat. Wheat was the leading grain in the ration fed to the fowls in house No. 3; corn the leading whole grain fed in the other house, No. 4. The results with the fowls in these houses, like the results obtained in houses Nos. 1 and 2, afford a basis for estimating the relative value of wheat and corn, but with a relatively low percentage of fat in both. The nutritive ratios used in this experiment were, for the ration containing wheat, 1 to 4.54; for the ration containing corn, 1 to 6.28. The egg product in this experiment was as follows: for the first period, January 25 to April 28, inclusive, for the wheat ration .49 and for the corn ration .47 eggs per hen day; for the summer period, April 28 to September 5, inclusive, for the wheat ration .35 and for the corn ration .46 eggs per hen day. In other words, 100 fowls, laying at similar rates, would have produced on the wheat ration 49 eggs per day during the winter period and 35 eggs per day during the summer period. On the corn ration, the same number of fowls would have laid 47 eggs per day during the winter period and 46 eggs per day during the summer period. It will be noticed that the result in the winter experiment is favorable to the ration containing the wheat. In the summer, on the other hand, it is favorable to the ration containing the corn. In the experiments reported last year the numbers of eggs both in the winter and in the summer period were greater on the wheat ration, although the cost per egg was less on the corn than on the wheat. In the experiments of the past year the gross cost of food per egg produced on the wheat ration has been

.96 cents both for the winter and summer periods. The gross cost of food per egg on the corn ration for the winter period was .86 cents and for the summer period .74 cents. This year, as last, therefore, the food cost per egg has been less on the corn than on the wheat. It is not easy to understand why the results as measured by the number of eggs produced in one instance should have been favorable to the wheat and in the other to the corn, but it may be that the difference in the average temperature of the two seasons in part accounts for it. It will be remembered that both rations in this experiment are low in fat. One of the products of protein metabolism in the animal body is fat, and fat, as is well understood, is the most effective heat producer. The higher protein content of the ration containing the more wheat may have proved serviceable, therefore, in enabling the fowls the better to maintain normal body temperatures during the cool weather. True, it is generally asserted that corn may be used more freely as a food for laying fowls in winter than in summer. It will be remembered, however, that in this experiment the fat content of the wheat ration was made equal to that of the corn ration by the addition of corn oil. It would seem, therefore, that, while the results in the two periods this year are not in exact agreement, they nevertheless in a general way support the conclusion which has previously been tentatively suggested, viz.: that, unless the fat content of the ration is relatively high, the more starchy foods are not sufficient to produce a satisfactory egg yield, and the product falls below that obtained from feeding a ration higher in protein.

3. The fowls in houses Nos. 5 and 6 received rations in both cases characterized by low protein, high ash and high fat content. The deficiency in fat in the grains selected was made up by the use of corn oil mixed with the meals used in the mash, as in the other experiments. The fowls in house No. 5 were fed grains, including oats and oat feed, characterized by a high proportion of fiber. Those in house No. 6 were fed grains among which rice, which is characterized by a very low percentage of fiber, was prominent. The object in this experiment was to get light regarding the influence

of fiber in the ration on egg production. The nutritive ratio in the two houses was kept substantially the same, about 1 to 6.5. The animal food used in these houses was beef scraps. The results were as follows: For the winter period, January 25 to April 28, inclusive, the egg production was: for the oat ration (high fiber), .32 per hen day; for the rice ration (low fiber), .46. For the summer period, April 28 to September 5, inclusive, the egg production was: for the oat ration (high fiber), .32; and for the rice ration (low fiber), .37 per hen day. In other words, 100 fowls, laying at the same rates, would have produced daily during the winter period, on the oat ration, 32 eggs; on the rice ration, 46 eggs; during the summer period, on the oat ration, 32 eggs; on the rice ration, 37 eggs. The food cost of the eggs was greater on the rice ration than on the oat ration. As has been pointed out in earlier reports, rice, on account of its high price, cannot as a rule be economically used as a food for laying fowls. It is used in this experiment because of its exceptionally low fiber content. The results of the past year are in exact accord with all earlier experiments testing this point. A large proportion of fiber in a ration for laying fowls seems to be highly unfavorable to a satisfactory egg product.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, EDWARD G. PROULX, E. T. LADD.

PART I. — Report on Official Inspection of Commercial Fertilizers.
PART II. — Report on General Work in the Chemical Laboratory.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1906.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 64; of these, 40 have offices for the general distribution of their goods in Massachusetts, 11 in New York, 8 in Connecticut, 3 in Vermont, 2 in Ohio, 1 in Rhode Island, 1 in Maryland, 1 in Tennessee, 1 in Arkansas, 1 in Missouri, 1 in Canada, 1 in New Jersey and 1 in Pennsylvania.

Three hundred and fifty-four brands of fertilizers and chemicals have been licensed in Massachusetts during the year. Five hundred and thirty-three samples of fertilizers have been collected up to December 10 in our general markets by an experienced assistant in this department.

Four hundred and ninety-seven samples of officially collected fertilizers have been analyzed at the present date (December 10), representing 323 distinct brands of fertilizers. Some of these analyses were published in our July bulletin No. 111; the others will be published in our January bulletin. The analyses of other officially collected samples of fertilizers, not included in these two publications, will be published in our March bulletin for 1907. Twenty-eight more brands of fertilizers were licensed in Massachusetts during the year than in 1905, and 10 more have been analyzed than during the past year.

The following table shows the general character of the fertilizers analyzed during 1906, as compared with the previous year: —

	1905.	1906.
(*a*) Where three essential elements of plant food were guaranteed (complete fertilizers): —		
Number with three elements equal to or above the highest guarantee,	11	9
Number with two elements above the highest guarantee, . . .	15	22
Number with one element above the highest guarantee, ...	59	71
Number with three elements between the highest and lowest guarantee,	100	106
Number with two elements between the highest and lowest guarantee,	74	71
Number with one element between the highest and lowest guarantee,	24	41
Number with three elements below the lowest guarantee, . . .	1	0
Number with two elements below the lowest guarantee, . . .	14	14
Number with one element below the lowest guarantee, ...	48	45
(*b*) Where two essential elements of plant food were guaranteed (bones, tankage, fish and ashes): —		
Number with two elements above the highest guarantee, . . .	5	3
Number with one element above the highest guarantee, ...	22	20
Number with two elements between the lowest and highest guarantee,	12	7
Number with one element between the lowest and highest guarantee,	14	18
Number with two elements below the lowest guarantee, . . .	2	4
Number with one element below the lowest guarantee, ...	13	8
(*c*) Where one essential element of plant food was guaranteed (chemicals): —		
Number above the highest guarantee, ...	11	13
Number between the lowest and highest guarantee, ...	13	18
Number below the lowest guarantee, ...	10	13

The quality of the officially collected fertilizers for 1906, as shown by the above table, shows a gain over the previous year.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1905 and 1906 (Cents per Pound).

	1905.	1906.
Nitrogen in ammonia salts,	17.50	17.50
Nitrogen in nitrates,	17.00	16.50
Organic nitrogen in dry and fine ground fish, meat, blood, and in high-grade mixed fertilizers,	18.50	18.50
Organic nitrogen in fine bone and tankage,	18.00	18.00
Organic nitrogen in coarse bone and tankage,	13.00	13.00
Phosphoric acid soluble in water,	4.50	4.50
Phosphoric acid soluble in ammonium citrate,	4.00	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and neutral citrate of ammonia) in mixed fertilizers,	2.00	2.00
Potash as sulphate (free from chlorides),	5.00	5.00
Potash as muriate (chloride),	4.25	4.25
Potash as carbonate,	8.00	8.00

A comparison of the market cost of the various forms in which the three essential elements of plant food are found shows the nitrogen in the form of nitrates to be a half-cent lower in cost than for the previous year; the cost of the other forms of nitrogen, as well as the various sources of potash and phosphoric acid, remains the same as for 1905.

The above schedule of trade values was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey experiment stations, at a conference held during the month of February, 1906, and is based upon the condition of the fertilizer market in centers of distribution in New England, New York and New Jersey during the six months preceding March, 1906, and refers to the current market prices, in ton lots, of the leading standard raw materials which furnish nitrogen, phosphoric acid and potash, and which enter largely into the manufacture of our commercial fertilizers.

Table A, on a following page, gives the average composition of licensed commercial fertilizers for 1906.

Table B gives a compilation of analyses of the so-called special crop fertilizers, and shows the wide variation in the chemical composition of this class of goods, the variation in some cases amounting to 10 or 12 per cent. in some one element of plant food which is recommended and used by different manufacturers in compounding a fertilizer for some special crop. This is proof positive that the purchaser of commercial fertilizers must have some more reliable method of selecting his fertilizers than by using the manufacturers' trade names, which, being so contradictory, confuse rather than aid the intelligent buyer. No infallible rule can be laid down in selecting a fertilizer, as so much depends upon the method of crop rotation, the kind of farming in practice, and general soil conditions and requirements. The user of commercial fertilizers will, however, make no mistake in selecting a *high-grade* fertilizer; but whether to select a fertilizer containing a high percentage of some one element of plant food, and how to be guided in this matter, must rest with the individual consumer. The plant food requirements of different soils, as well as different crops, vary widely; and the farmer must discover what particular fertilizing element or elements will most benefit his soil, and select his fertilizer accordingly.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1906 (Per Cent.).*

NATURE OF MATERIAL.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
							TOTAL.		AVAILABLE.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
General fertilizer,	10.18	3.14	2.71	4.18	3.42	2.91	10.51	8.91	7.60	7.30	5.30	5.05
Ground bone,	6.80	2.98	2.56	–	8.54	16.33	24.87	22.38	8.54	7.81	–	–
Tankage,	9.72	5.39	5.19	–	6.15	10.19	16.34	14.73	6.15	–	–	–
Dry ground fish,	8.26	8.14	8.24	–	3.86	3.95	7.82	6.80	3.86	–	–	–
Basic slag,	–	–	–	–	6.72	12.27	18.99	18.00	6.72	–	–	–
Dissolved bone black,	12.11	–	–	10.77	4.92	1.21	17.01	16.00	15.70	15.00	–	–
Dissolved bone,	6.61	2.46	1.65	5.60	8.42	3.08	17.10	14.00	14.02	12.00	–	–
Acid phosphate,	12.62	–	–	10.85	3.97	1.52	16.34	11.66	14.82	13.00	–	–
Wood ashes,	13.96	–	–	–	–	–	1.33	1.12	–	–	5.77	4.80
Nitrate of soda,	1.76	15.57	15.42	–	–	–	–	–	–	–	–	–
Sulfate of ammonia,	.76	20.78	19.00	–	–	–	–	–	–	–	–	–
Dried blood,	7.55	9.30	9.50	–	–	–	–	–	–	–	–	–
Cotton-seed meal,	6.91	6.69	6.46	–	–	–	–	–	–	–	–	–
Cleveland flax meal,	9.52	6.00	5.76	–	–	–	–	–	–	–	–	–
Chincha Peruvian guano,	10.65	7.33	7.06	2.49	4.80	2.72	10.01	8.50	7.29	6.50	1.88	2.00
Lobos Peruvian guano,	10.40	3.41	3.15	2.78	5.75	9.04	17.57	19.00	8.53	10.00	3.90	3.30
Carbonate of potash,	None.	–	–	–	–	–	–	–	–	–	67.10	67.00
Sulfate of potash,	.84	–	–	–	–	–	–	–	–	–	49.34	48.25
Muriate of potash,	1.36	–	–	–	–	–	–	–	–	–	50.42	50.00
Sulfate of potash-magnesia,	3.95	–	–	–	–	–	–	–	–	–	25.92	26.00
Kainit,	2.07	–	–	–	–	–	–	–	–	–	12.84	12.00

TABLE B. — *Compilation of Analysis of Officially Collected Fertilizers for 1906, Special Crop Brands (Per Cent.).*

NAME OF FERTILIZER.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.			TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			POTASSIUM OXIDE IN ONE HUNDRED POUNDS.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	10.77	4.16	1.61	2.61	16.64	9.22	11.55	9.66	5.12	8.39	10.94	1.80	4.00
Fruit and vine,	9.77	2.78	2.50	2.64	13.86	7.24	10.55	10.84	3.78	7.31	11.42	3.32	7.37
Grass fertilizer,	7.89	5.69	3.10	4.27	14.32	4.84	9.17	10.98	2.78	6.38	8.30	2.06	5.28
Market garden fertilizer,	9.77	4.68	2.03	3.19	14.00	7.16	10.65	10.08	5.76	7.63	12.08	2.06	6.67
Onion fertilizer,	10.72	4.31	3.62	3.88	12.10	7.88	10.18	9.98	6.50	7.80	7.98	6.28	6.95
Potato fertilizer,	10.80	5.62	1.32	2.81	15.46	6.70	10.61	9.72	4.16	7.68	10.14	3.10	6.09
Root crop fertilizer,	10.56	3.66	2.75	3.28	11.90	9.86	10.89	8.90	7.26	8.22	7.66	6.50	7.23
Tobacco fertilizer,	8.56	8.56	1.09	4.42	15.08	4.24	8.06	9.14	2.40	5.85	15.88	2.62	6.40

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1906, to May 1, 1907), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- High-grade Fertilizer with Ten Per Cent. Potash.
- Grass and Lawn Top-dressing.
- Tobacco Starter and Grower.
- Fine-ground Bone.
- Dissolved Bone Black.
- Muriate of Potash.
- Double Manure Salt.
- High-grade Sulfate of Potash.
- Nitrate of Soda.
- Dry Ground Fish.
- Plain Superphosphate.
- Sulfate of Ammonia.
- Kainit.
- Dried Blood.
- Fine-ground Tankage.
- Ground South Carolina Phosphate.
- High-grade Tobacco Manure.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Bradley's Complete for Potatoes and Vegetables.
- Bradley's Complete for Corn and Grain.
- Bradley's Complete Manure with Ten Per Cent. Potash.
- Bradley's Complete Top-dressing Grass and Grain.
- Bradley's X. L. Superphosphate.
- Bradley's Potato Manure.
- Bradley's Potato Fertilizer.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.
- Bradley's Niagara Phosphate.
- Bradley's English Lawn Fertilizer.
- Bradley's Columbia Fish and Potash.
- Bradley's Abattoir Bone Dust.
- Bradley's Seeding-down Manure.
- Church's Fish and Potash.

The American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's A. A. Ammoniated Superphosphate.
- Baker's Complete Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer G. G.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass. — *Con.*
- Clark's Cove Great Planet Manure.
- Clark's Cove Potato Manure.
- Clark's Cove Potato Fertilizer.
- Clark's Cove King Philip Guano.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's Corn Phosphate.
- Crocker's A. A. Complete Manure.

The American Agricultural Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
- Darling's Blood, Bone and Potash.
- Darling's Complete Ten Per Cent. Manure.
- Darling's Potato Manure.
- Darling's Farm Favorite.
- Darling's Potato and Root Crop Manure.
- Darling's General Fertilizer.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
- Great Eastern Northern Corn Special.
- Great Eastern Vegetable Vine and Tobacco.
- Great Eastern Garden Special.
- Great Eastern General.
- Great Eastern Grass and Oats Fertilizer.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
- Pacific High-grade General.
- Pacific Potato Special.
- Soluble Pacific Guano.
- Pacific Nobsque Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
- Packers' Union Gardeners' Complete Manure.
- Packers' Union Animal Corn Fertilizer.
- Packers' Union Potato Manure.
- Packers' Union Universal Fertilizer.
- Packers' Union Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
- Quinnipiac Market-garden Manure.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Potato Phosphate.
- Quinnipiac Corn Manure.
- Quinnipiac Climax Phosphate.
- Quinnipiac Onion Manure.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
- Read's Practical Potato Special.
- Read's Farmer's Friend.
- Read's Standard.
- Read's High-grade Farmer's Friend.
- Read's Vegetable and Vine.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass.: —
- Standard Complete Manure.
- Standard Fertilizer.
- Standard Special for Potatoes.
- Standard Guano.

The American Agricultural Chemical Co. (Henry F. Tucker Co., branch), Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Special Potato.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass.: —
- Williams & Clark's High-grade Special.
- Williams & Clark's Americus Phosphate.
- Williams & Clark's Potato Phosphate.
- Williams & Clark's Potato Manure.
- Williams & Clark's Corn Phosphate.
- Williams & Clark's Royal Bone Phosphate.
- Williams & Clark's Prolific Crop Producer.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
- Wheeler's Corn Fertilizer.
- Wheeler's Potato Manure.
- Wheeler's Havana Tobacco Grower.
- Wheeler's Bermuda Onion Grower.
- Wheeler's Grass and Oats Fertilizer.

W. H. Abbott, Holyoke, Mass.: —
- Abbott's Tobacco Fertilizer.
- Abbott's Onion Fertilizer.
- Abbott's Animal Fertilizer.
- Abbott's Eagle Brand Fertilizer.

The American Cotton Oil Co., New York City: —
- Cotton-seed Meal.
- Cotton-hull Ashes.

The American Linseed Co., New York, N. Y.: —
- Cleveland Flax Meal.

The Armour Fertilizer Works, Baltimore, Md.: —
- Fruit and Root Fertilizer.
- Blood, Bone and Potash.
- High-grade Potato.
- All Soluble.
- Ammoniated Bone with Potash.
- Bone Meal.
- Complete Potato.
- Corn King.
- Market Garden.
- Grain Grower.

H. J. Baker & Bro., New York, N. Y.: —
- Castor Pomace.

Beach Soap Co., Lawrence, Mass.: —
- Beach's Advance Brand.
- Beach's Reliance Brand.

Berkshire Fertilizer Co., Bridgeport, Conn.: —
- Berkshire Complete Fertilizer.
- Berkshire Potato and Vegetable Phosphate.
- Berkshire Ammoniated Bone Phosphate.
- Berkshire Grass Fertilizer.

Joseph Breck & Sons, Boston, Mass.: —
- Breck's Lawn and Garden Dressing.
- Breck's Market-garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.

Bowker Fertilizer Co., Boston, Mass. — *Con.*
- Bowker's Lawn and Garden Dressing.
- Bowker's Potato and Vegetable Fertilizer.
- Bowker's Fish and Potash (Square Brand).
- Bowker's Potato and Vegetable Phosphate.
- Bowker's Sure Crop Phosphate.
- Gloucester Fish and Potash.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Bowker's Fish and Potash ("D" Brand).
- Bowker's Corn Phosphate.
- Bowker's Bone, Blood and Potash.
- Bowker's Early Potato Manure.
- Bristol Fish and Potash.
- Bowker's Fine-ground Fish.
- Bowker's Tobacco Ash Elements.
- Bowker's Wood Ashes.
- Bowker's Ground Bone.
- Bowker's Superphosphate.
- Bowker's Sulfate of Ammonia.
- Bowker's Nitrate of Soda.
- Bowker's Dissolved Bone Black.
- Bowker's Kainit.
- Bowker's Muriate of Potash.
- Bowker's Sulfate of Potash.
- Dried Blood.
- Bowker's Soluble Animal Fertilizer.
- Bowker's Tobacco Starter.
- Bowker's Tobacco Ash Fertilizer.
- Bowker's Market-garden Fertilizer.
- Bowker's Potash Bone.
- Bowker's Ten Per Cent. Manure.
- Bowker's Complete Mixture.
- Bowker's Ammoniated Food for Flowers.
- Bowker's Double Manure Salt.
- Bowker's Tankage.
- Bowker's Clover Brand Bone and Wood Ash Fertilizer.
- Bowker's Flour of Bone.
- Bowker's Market Bone.
- Bowker's Ground Phosphate Rock.
- Bowker's Ammoniated Dissolved Bone.
- Bowker's Square Brand Bone and Potash.
- Bowker's Potash or Staple Phosphate.
- Bowker's Special Fertilizer for Seeding Down.

F. W. Brode & Co., Memphis, Tenn.: —
- Owl Brand Cotton-seed Meal.

T. H. Bunch Co., Little Rock, Ark.: —
- Cotton-seed Meal.

The Buffalo Fertilizer Co., Buffalo, N. Y.: —
- Fish Guano.
- Farmer's Choice.
- York State Special.
- Vegetable and Potato.
- Garden Truck.
- High-grade Manure.

Charles M. Cox Co., Boston, Mass.: —
- Cotton-seed Meal.

Chicopee Rendering Co., Springfield, Mass.: —
- Farquhar's Lawn and Garden Dressing.
- Farquhar's Vegetable and Potato Fertilizer.

The Coe-Mortimer Co., New York, N. Y.: —
- New Englander Corn and Potato Fertilizer.
- Columbian Corn and Potato Fertilizer.
- Basic Slag.
- Excelsior Potato Fertilizer.
- Gold Brand Excelsior Guano.
- X X X Ammoniated Bone Phosphate.
- Nitrate of Soda.
- Celebrated Special Potato.
- High-grade Ammoniated Bone Superphosphate.
- Chincha Peruvian Guano.
- Lobos Peruvian Guano.

John C. Dow & Co., Boston, Mass.: —
- Dow's Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
- Imperial Plant Food.

R. & J. Farquhar & Co., Boston, Mass.: —
- Canada Unleached Hard-wood Ashes.
- Clay's London Fertilizer.

Fyfe, Fay & Plummer, Clinton, Mass.: —
- Hard-wood Canada Ashes.

C. B. Hastings, Ashmont, Mass.: —
- Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.: —
- Meat and Bone.
- Bone Meal.

The Home Soap Co., Worcester, Mass.: —
Ground Bone.

Hunter Brothers Milling Co., St. Louis, Mo.: —
Cotton-seed Meal.

John Joynt, Lucknow, Ontario, Can.: —
Unleached Hard-wood Ashes.

A. Klipstein & Co., New York, N. Y.: —
Carbonate of Potash.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Lister's High-grade Special.
Lister's Success.
Lister's Special Corn.
Lister's Special Potato.
Lister's Potato Manure.
Lister's Oneida Special.
Lister's Bone and Potash.

Stephen Major, South Somerset, Mass.: —
Major's Bone Phosphate No. 1.

Edward MacMulkin, Boston, Mass.: —
Ideal Plant Food.

Swift's Lowell Fertilizer Co., Boston, Mass.: —
Swift's Lowell Bone Fertilizer.
Swift's Lowell Potato Phosphate.
Swift's Lowell Dissolved Bone and Potash.
Swift's Lowell Animal Brand.
Swift's Lowell Market-garden Manure.
Swift's Lowell Potato Manure.
Swift's Lowell Empress Brand.
Swift's Lowell Superior Fertilizer.
Swift's Lowell Special Grass Mixture.
Swift's Lowell Lawn Dressing.
Swift's Lowell Perfect Tobacco Grower.
Swift's Lowell Ground Bone.
Acid Phosphate.
Nitrate of Soda.
Muriate of Potash.
Tankage.
Dried Blood.
High-grade Sulfate of Potash.
Dissolved Bone Black.
Swift's Lowell Special Vegetable Fertilizer.

George E. Marsh & Co., Lynn, Mass.: —
Bone Meal.

Mapes Formula & Peruvian Guano Co., New York, N. Y.: —
Mapes' Grass and Grain Spring Top-dressing.
Mapes' Complete Manure for General Use.
Mapes' Fruit and Vine Manure.
Mapes' Cereal Brand.
Mapes' Lawn Top-dressing.
Mapes' Cauliflower and Cabbage Manure.
Mapes' Potato Manure.
Mapes' Tobacco Starter Improved.
Mapes' Tobacco Manure (Wrapper Brand).
Mapes' Economical Potato Manure.
Mapes' Average Soil Complete Manure.
Mapes' Vegetable Manure or Complete Manure for Light Soils.
Mapes' Corn Manure.
Mapes' Complete Manure ("A" Brand).
Mapes' Complete Manure Ten Per Cent. Potash.
Mapes' Top-dressing Improved, Half Strength.
Mapes' Tobacco Ash Constituents.

George L. Monroe & Sons, Oswego, N. Y.: —
Pure Canada Unleached Wood Ashes.

D. M. Moulton, Monson, Mass.: —
Ground Bone.

W. H. Nash, Boston, Mass.: —
Lime-Kiln Ashes.

National Fertilizer Co., Bridgeport, Conn.: —
Chittenden's Ammoniated Bone.
Chittenden's Universal.
Chittenden's Potato Phosphate.
Chittenden's Complete.
Chittenden's Fish and Potash.
Chittenden's Tobacco Starter.
Chittenden's Tobacco Grower.
Chittenden's Market Garden.
Chittenden's Tobacco Special.
Chittenden's Complete Tobacco.
Chittenden's High-grade Special Tobacco.

New England Fertilizer Co., Boston, Mass.: —
New England Corn Phosphate.
New England Potato Fertilizer.
New England Superphosphate.
New England High-grade Potato Fertilizer.

Olds & Whipple, Hartford, Conn.: —
- Complete Tobacco Fertilizer.
- Home Mixture for Onions.
- Vegetable Potash.
- Corn and Potato Fertilizer.
- Cotton-seed Meal.

R. T. Prentiss, Holyoke, Mass.: —
- Complete Fertilizers.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
- Plymouth Rock Brand.
- Strawberry Special.
- Special Potato.
- A. A. Brand.
- P. & P. Potato.
- Lawn Dressing.
- P. & P. Grain Grower.
- Star Brand.
- Pure Ground Bone.
- Nitrate of Soda.
- Aroostook Special.

Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Complete Phosphate.
- Hubbard's Grass and Grain Fertilizer.
- Hubbard's Market-garden Phosphate.
- Hubbard's Oats and Top-dressing.
- Hubbard's Potato Phosphate.
- Hubbard's Soluble Corn and General Crops.
- Hubbard's Soluble Potato Manure.
- Hubbard's Soluble Tobacco Manure.
- Hubbard's Raw Knuckle Bone Flour.
- Hubbard's Strictly Pure Fine Bone.

Rogers Manufacturing Co., Rockfall, Conn.: —
- All-round Fertilizer.
- Complete Potato and Vegetable Fertilizer.
- High-grade Complete Corn and Onion.
- Fish and Potash.
- High-grade Tobacco and Potato.
- High-grade Oats and Top-dressing.
- High-grade Grass and Grain.
- High-grade Soluble Tobacco.
- Pure Knuckle Bone.

Ross Brothers, Worcester, Mass.: —
- Lawn and Garden Fertilizer.

N. Roy & Son, South Attleborough, Mass.: —
- Potato Fertilizer.
- Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
- Essex Dry Ground Fish.
- Essex Complete for Corn, Grain and Grass.
- Essex Complete for Potatoes, Roots and Vegetables.
- Essex Market-garden and Potato Manure.
- Essex Corn Fertilizer.
- Essex A. 1. Superphosphate.
- Essex X X X Fish and Potash.
- Essex Odorless Lawn Dressing.
- Essex Tobacco Starter.
- Essex Special Tobacco Manure.
- Essex Rhode Island Special for Potatoes.
- Essex Grass and Top-dressing.
- Essex Nitrate of Soda.

The Salisbury Cutlery Handle Co., Salisbury, Conn.: —
- Ground Bone.

Sanderson's Fertilizer & Chemical Co., New Haven, Conn.: —
- Sanderson's Formula "A."
- Sanderson's Formula "B."
- Sanderson's Top-dressing Grass and Grain.
- Sanderson's Potato Manure.
- Sanderson's Atlantic Coast Bone, Fish and Potash.
- Sanderson's Fine-ground Fish.
- Nitrate of Soda.
- High-grade Sulfate of Potash.
- Muriate of Potash.
- Plain Superphosphate.
- Walker's Complete Phosphate.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.: —
- Swift Sure Superphosphate.
- Swift Sure Bone Meal.

The Smith Agricultural Chemical Co. (Abbott and Martin Rendering Co., branch), Columbus, O.: —
- Harvest King.
- Tobacco and Potato Special.
- Martin's Truck Fertilizer.

The Smith Agricultural Chemical Co. (Hardy Packing Co., branch), Columbus, O.: —
- Tankage, Bone and Potash.
- Tobacco and Potato Special.

Sterling Chemical Co., Cambridgeport, Mass.: —
  Sterlingworth Concentrated Plant Food.

Thomas L. Stetson, Randolph, Mass.: —
  Stetson's Ground Bone.

A. L. Warren, Northborough, Mass.: —
  Warren's Ground Bone.

Whitman & Pratt Rendering Co., Lowell, Mass.: —
  Vegetable Grower.
  All Crops Fertilizer.
  Corn Success.
  Potato Plowman.
  Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.: —
  Potato, Onion and Vegetable Manure.
  Potato Fertilizer.
  Complete Bone Superphosphate.
  Fish and Potash.
  High-grade Tobacco Special.
  Dry Ground Fish.

Sanford Winter, Brockton, Mass.: —
  Winter's Ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
  Tankage.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

C. A. GOESSMANN.

1. Analyses of materials forwarded for examination.
2. Notes on wood ashes and lime ashes.

1. ANALYSES OF MATERIALS FORWARDED FOR EXAMINATION.

During the year 343 samples of miscellaneous substances have been received from farmers within our State. These samples have been analyzed as expeditiously as possible, the samples being taken up, as a rule, in the order of their arrival at this office; although precedence is sometimes given to farmers' clubs, grange organizations and private parties, who depend upon the results of our analysis as a basis for settlement for their fertilizers. We have most time at our disposal for this class of work from the middle of December until the first of April, as during this time we are not engaged in the annual inspection of commercial fertilizers. Whenever practical, it would be well for those who desire a speedy return of results of analyses to take advantage of this fact, and send samples for analysis before the beginning of our inspection season.

During the year we have been in co-operation with the Association of Official Agricultural Chemists, studying new methods of analyses of soils, fertilizers and insecticides. This is a very important part of the practical chemists' work, and time should be taken every year for this co-operative investigation.

The year has seen some new developments along the line of producing valuable agricultural compounds for fertilizing purposes. These developments have naturally inclined towards producing new compounds of our most expensive element of plant food, nitrogen. Statistics show that, at the present rate of consumption, it is only a matter of a few years before the supply of nitrate of soda from our present source will become exhausted. This will become a very serious matter, unless new deposits of nitrate are discovered, or science shows us an economical method of utilizing the inexhaustible supply of atmospheric nitrogen. Attempts have been made to manufacture nitric acid by an electrical method which utilizes the nitrogen of the air, and which has proven more or less successful. Attempts have also been made to combine the atmospheric nitrogen with lime to form cyanimid compounds. This method has also been successful, but whether these cyanimid compounds will prove practical fertilizers or not we are at present unable to say. It has long been known that cyanogen compounds are poisonous to plant growth; but they are easily decomposed, and it is possible that it may be found safe to use them by applying them to the soil some time previous to the planting of the crop.

During the year we have heard much about the use of ground feldspar and granitic rocks as a source of potash. In the early history of the use of artificial fertilizers, potash in the form of silicates was recommended. They were, however, found unsuitable as a source of potash, as they were not easily decomposed, and the more soluble forms of potash soon took their place. It is a well-known fact that many soils of granitic origin are benefited by an application of soluble potash compounds. In view of the above facts, we would caution the user of commercial fertilizers against purchasing ground feldspathic rocks as a source of potash. Through a process of electrolysis and endosmosis, investigators have succeeded in recovering 80 per cent. of the potash in feldspathic rocks. In this age of cheapening electrical power it may not be impossible that this process may be successfully employed to economically produce potash for our future needs in the fertilization of agricultural soils for farm crops.

Following is a partial list of materials forwarded by farmers during the year: —

Soils,	55
Complete fertilizers,	45
Wood ashes,	41
Cotton-seed meal,	28
Nitrate of soda,	13
Peruvian guano,	11
Carbonate of potash,	7
Sulfate of potash,	8
Ground bones,	6
Dry ground fish,	6
Fine-ground tankage,	6
Lime ashes,	6
Paris green,	6
Dried blood,	4
Dissolved bone black,	4
Muriate of potash,	4
Cotton waste,	4
Sheep manure,	4
Lime,	3
Dissolved bone,	3
Sulfate of potash-magnesia,	3
Nitrate of potash,	3
Arsenate of lead,	3
Acid phosphate,	4
Phosphatic slag,	3
Oyster-shell lime,	2
Linseed meal,	2
Muck,	2
Granite,	2
Talc,	2
Cotton-hull ashes,	2
Leather refuse,	2
Glue refuse,	1
Cave deposit,	1
Carbonate of lime,	1
Leather dust,	1
Tobacco stems,	1
Kainit,	1
Pigeon manure,	1
Clay,	1
Bone soup,	1
Peat,	1
Wool washings,	1
Arsenate of soda,	1
London purple,	1
Saltpeter waste,	1
Bone waste,	1
Horn waste,	1
Coal ashes,	1
Sludge from filter beds,	1
Hoof meal,	1
South Carolina rock phosphate,	1
Manure,	1
Sulfate of ammonia,	1
Steamed bone,	1
Manure and lime,	1
Bone scrap,	1
Burned bone,	1
Carbonate of potash-magnesia,	1
Calcium cyanimid,	1
Washings from paper mill,	1
Soft coal soot,	1
Castor pomace,	1
Nitrogenous chalk,	1
Peat and manure,	1
Wool waste,	1
River mud,	1
Woodland leaf mold,	1
Miscellaneous,	12

2. Notes on Wood Ashes and Lime Ashes.

(a) Wood Ashes.

Forty-one samples of wood ashes have been forwarded for analysis by farmers during the past year. The majority of these ashes are used by the farmers in the Connecticut valley. The following table shows their chemical composition as compared with 1905: —

Analysis of Wood Ashes.

	Number of Samples.	
	1905.	**1906.**
Moisture from 1 to 10 per cent.,	15	8
Moisture from 10 to 20 per cent.,	20	19
Moisture from 20 to 30 per cent.,	7	10
Moisture above 30 per cent.,	1	0
Potassium oxide above 7 per cent.,	4	3
Potassium oxide from 6 to 7 per cent.,	4	7
Potassium oxide from 5 to 6 per cent.,	12	6
Potassium oxide from 4 to 5 per cent.,	13	9
Potassium oxide from 3 to 4 per cent.,	7	9
Potassium oxide below 3 per cent.,	3	2
Phosphoric acid above 2 per cent.,	7	1
Phosphoric acid from 1 to 2 per cent.,	32	31
Phosphoric acid below 1 per cent.,	4	6
Average per cent. of calcium oxide,	32.30	28.17
Insoluble matter below 10 per cent.,	9	3
Insoluble matter from 10 to 15 per cent.,	14	16
Insoluble matter above 15 per cent.,	20	18

Table showing Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Wood Ashes, 1905 and 1906.

	Maximum.		Minimum.		Average.	
	1905.	**1906.**	**1905.**	**1906.**	**1905.**	**1906.**
Moisture at 100° C.,	32.05	26.17	.02	.65	13.45	14.78
Potassium oxide,	8.68	7.54	2.32	2.75	5.09	5.02
Phosphoric acid,	4.74	2.90	.38	.44	1.69	1.28
Calcium oxide,	49.24	35.60	21.17	19.28	32.30	28.17
Insoluble matter,	33.32	30.25	4.15	4.04	15.49	16.02

A comparison of the figures in the above tables shows that the ashes analyzed during the season contained, on the average, less potash, phosphoric acid and lime and more water and sand than during the previous year. This emphasizes the importance of buying this class of material on a statement of guarantee of potash, phosphoric acid and lime; also of patronizing those importers who have complied with our State laws, and have secured licenses for the sale of wood ashes in Massachusetts. A list of these importers will be found on a previous page of this report.

(*b*) *Lime Ashes.*

Table showing Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Lime Ashes, 1905 and 1906.

	MAXIMUM.		MINIMUM.		AVERAGE.	
	1905.	**1906.**	**1905.**	**1906.**	**1905.**	**1906.**
Moisture at 100° C.,	19.35	21.65	.05	none.	11.18	5.99
Potassium oxide,	4.80	3.72	1.02	1.44	2.46	2.54
Phosphoric acid,	1.58	1.16	.18	.34	.97	.71
Calcium oxide,	63.44	49.74	37.56	29.33	49.34	40.39
Insoluble matter,	28.93	34.93	3.21	4.04	8.99	9.51

The average composition of lime ashes is about the same as for the previous year.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Chemists: E. B. HOLLAND, P. H. SMITH, A. C. WHITTIER,[1] L. S. WALKER.[2]
Inspector of Feeds and Babcock Machines: F. G. HELYAR,[3] W. K. HEPBURN.
Dairy Tester: S. R. PARKER,[4] H. A. PARSONS.
In Charge of Feeding Experiments: R. F. GASKILL.
Clerk and Stenographer: MABEL C. SMITH.

PART I. — OUTLINE OF THE YEAR'S WORK.
- Correspondence.
- Summary of laboratory work.
- Water analysis.
- Dairy products and cattle feeds.
- Special chemical work.
- Execution of feed law.
- Execution of dairy law.
- The testing of pure-bred cows.
- Work completed.
- Work in progress.
- Changes in staff.

PART II. — WORK IN ANIMAL NUTRITION.
- The digestibility of cattle feeds.

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[1] Resigned July 1.
[2] Since July 1.
[3] Resigned October 1.
[4] Resigned June 1.

Part I. — Outline of the Year's Work.

J. B. LINDSEY.

Correspondence.

A considerable correspondence is carried on yearly with farmers, grain dealers and other station workers. Numerous questions are asked concerning feeds and methods of feeding. The execution of the dairy and feed law involves the exchange of many letters. Letters of all kinds, sent from Dec. 15, 1905, through Dec. 15, 1906, approximated 3,200.

Summary of Laboratory Work.

From Dec. 15, 1905, to Dec. 15, 1906, there have been received and examined 124 samples of water, 310 of milk, 1,799 of cream, 152 of feed stuffs and 2 miscellaneous. In connection with experiments made by this and other divisions of the station, there have been examined, in whole or in part, 336 samples of milk and cream and 187 of cattle feeds. There have also been collected and examined 703 samples of cattle feeds, in accordance with the requirements of the feed law. The total for the year has been 3,613, as compared with 4,042 in 1905 and 4,261 during 1904. Work with condensed milk, molasses, maple sugar, ash and nitrogen, not included in the above summary, has been carried on for the Association of Official Agricultural Chemists. Twenty-three candidates have been examined and given certificates to operate Babcock machines, and 2,457 pieces of Babcock glassware have been tested for accuracy of graduation.

Water Analysis.

The station continues to make sanitary analyses of drinking waters, at a charge of $3 each. Special jars are furnished, together with full instructions for collecting and forwarding the samples. An analysis of water sent in shippers' jars will not be made, neither will bacteriological nor mineral analyses be undertaken.

The character of the samples received has been much the same as that of those examined in previous years. They were mostly from wells or springs, which frequently were located in too close proximity to houses, barns and outbuildings, and received the drainage. Samples are often found contaminated with lead; the station can only repeat its warning that all lead pipe be discarded, and replaced with iron coated with asphaltum, or with galvanized-iron pipe.

Dairy Products and Cattle Feeds.

Farmers and dairymen continue to send samples of cream and skim milk to be tested for butter fat, and samples of whole milk to be tested for both solids and fat. More milk is being sold for market purposes than formerly, and less made into butter. The inspection of the quality of milk is more general and rigid from year to year. Dairymen wish to ascertain the composition of milk produced by individual cows and by their herds, and likewise to confirm analyses reported to them by the city milk inspectors and by contractors. This work is performed gratis, and the results reported promptly, together with such remarks and suggestions as special cases call for. One creamery sends all of the cream samples to be tested regularly, and others send occasional lots when not in condition to perform the work. A charge sufficient to cover the cost is made in such cases.

Samples of feeds (mostly concentrates) are received from farmers, as well as from local grain dealers and jobbers. The station willingly examines such material without charge, when it seems that the conditions warrant it, and promptly reports its findings with suggestions when necessary. It must be understood, however, that it cannot become the free chemists of jobbers and manufacturers who wish to have analyses made purely for commercial purposes.

Special Chemical Work.

This division has devoted some time to a study of methods used in chemical analysis, in co-operation with the Association of Official Agricultural Chemists. The work undertaken was as follows: —

1. A comparison of the Kjeldahl, Kjeldahl-Gunning and modified Gunning methods, for the determination of total organic nitrogen.

2. The determination of available organic nitrogen by the neutral permanganate and by the alkaline permanganate methods.

3. A study of the Babcock asbestos, dish and sand, and Gottlieb methods, Babcock centrifugal and Leach and Farrington modifications of the same, for the determination of fat in sweetened and unsweetened condensed milk.

4. Observations in the determination of lactose and sucrose in sweetened and unsweetened condensed milk, by aid of Fehling's solution, the copper being titrated with thiosulfate.

5. Determinations of moisture, ash, protein, dextrose and sucrose in massecuit, sugar and molasses. Considerable time was spent in a special study of different methods for the accurate determination of moisture in molasses, which has not been reported; it will be published when sufficient data have been secured to warrant the making of positive deductions.

6. Determinations of total, soluble and insoluble ash in pure and adulterated maple sugar, as well as the alkalinity of the soluble and insoluble ash.

The results of the above work were presented to the association, and became a part of their yearly report. It was carried out by Messrs. Holland and Smith, to whom due credit should be given.

In addition to the above, work is now in progress in determining the water and starch in 36 samples of potatoes.

EXECUTION OF THE FEED LAW (ACTS OF 1903, CHAPTER 122).

The methods employed in carrying out the provisions of this act have been essentially the same as in former years. The State has been thoroughly canvassed twice, the first time in January, February and March, and the second time in August, September and October. The inspector also spent the larger part of May in the most important grain-consuming portions of the State, and in addition made several short trips. There have been collected and examined during the year 703 samples of cattle and poultry feeds. Bulletin No. 108, containing the analyses of 365 samples collected during the autumn of 1905, was issued in January, 1906. Another bulletin is now being prepared for publication, and will be issued in December or early January. In addition to the regular yearly bulletin, the station sends out many letters to dealers and manufacturers concerning the values of feeds and explanatory of the feed law.

The only really adulterated feeds now on the market consist of mixtures of wheat bran and corn cobs. Such goods are usually properly guaranteed, but it is believed that unscrupulous dealers are inclined to remove the tags before selling, and dispose of them for genuine mixed wheat feeds.

Cotton-seed meal offered in local markets has shown a gradual decline in quality since 1902, while the price per ton has increased steadily since 1898. Gluten meal and germ oil meal are no longer offered. Distillers' dried grains are easily obtainable at reasonable prices. Brewers' dried grains of excellent quality have been placed in Massachusetts markets during the past year.

A number of proprietary grain mixtures or ready grain rations for dairy stock are now on sale, several of which are quite satisfactory; the price asked, however, is in excess of equally desirable mixtures which can be prepared by the dairymen from standard concentrates to be had of all local grain dealers.

Mixtures of corn, together with different amounts of oat residues, often designated stock foods, are widely distributed, and, judging from the number of brands, must find a ready sale. The corn is frequently of poor quality, being imperfectly developed, musty and sour. The price asked is usually in excess of their real value.

The number of brands of poultry foods, such as meat scraps, meat and bone meal, poultry meals and mashes, chick and scratching grains, is increasing from year to year. Poultrymen can prepare equally as desirable mashes or scratching mixtures for 25 cents less per hundred pounds. Full details concerning the great variety of cattle and poultry feeds now for sale in the markets of the State may be found by consulting the special feed bulletins.

Execution of the Dairy Law (Acts of 1901, Chapter 202).

The station has done its best to carry out the provisions of this law, which makes it obligatory for all creameries and milk depots in the State employing the Babcock test, or any other test for determining the value of milk or cream, to have all glassware used in making such determinations tested for accuracy of graduation. The law further requires that all parties intending to operate such machines be examined for competency by the proper station official. The station is also required once each year to send a competent party to each creamery and milk depot within the State where Babcock machines are in use, and pronounce upon their fitness for the work.

(*a*) *Inspection of Glassware.* — Each piece of glassware found to be correctly graduated has the letters "Mass Ex St" etched on. There were examined 2,457 pieces, of which 763, or 31.05 per cent., were condemned. This record shows gross carelessness on the part of some manufacturers.

(*b*) *Examination of Candidates.* — Twenty-three candidates have been examined during 1906. Some were well prepared, while others were refused a certificate on first trial and were obliged to take a second examination. The value of the law requiring the inspection of glassware and the examination of operators is made especially clear by the above records.

(*c*) *Inspection of Babcock Machines.* — The inspection of machines the present year has been in charge of Mr. William K. Hepburn, who makes the following report: —

The annual inspection of Babcock machines was made in November and December of 1906. Fifty-one places were either visited or heard from, but of these only 33 came under the law requiring inspection. Those not coming within the law have no machine in many cases, and as far as can be learned neither sell nor buy on the test basis.

Of the entire number, 28 are creameries and 23 milk depots. Nineteen of the creameries are co-operative, and 9 are either proprietary or managed by stock companies. The milk depots are in nearly every case proprietary. Thirty-three machines were inspected and found in good condition, only 1 needing minor repairs. Nearly all the machines in use have cast-iron frames, and of these 16 are Facile, 8 Agos and 3 Wizard. In addition to the above, there were in use 3 steam machines having galvanized frames and 3 electrical machines. In a few cases the machines still overheat the tests, but allowance is made for this by letting them run a little longer with the cover lifted.

Most of the glassware was found in good condition, although a few still use very dirty bottles, — a practice which cannot be too strongly condemned. Beside the regular inspection, four city milk inspectors were visited; they did not care to have their machines tested.

The following parties claim they do not pay on the Babcock basis, but by the space, can, 100 pounds or quart: —

Amherst Co-operative Creamery.
Fort River Creamery of Amherst.
Leominster Creamery.
Echo Farm Dairy of South Framingham.
Fitchburg Creamery.
Boston Dairy Company of Gardner.
James Lawrence Creamery of Groton.
Este Creamery of Marlborough.
F. D. Shove Creamery of West Stockbridge.
Wachusett Creamery of Worcester.
Worcester Dairy Company.

The following is a list of the most important creameries and milk depots now in operation: —

1. *Creameries.*

LOCATION.	Name.	President or Manager.
Amherst,	Amherst Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	E. A. King.
Ashfield,	Ashfield Co-operative,	G. G. Henry, manager.
Belchertown,	Belchertown Co-operative,	M. G. Ward, president.
Cheshire (P. O. Adams),	Greylock Co-operative,	C. J. Fales, president.
Cheshire,	Highland,	C. W. Prince.
Cheshire,	West Shore,	S. W. Curtis.
Cummington,	Cummington Co-operative,	W. E. Partridge, manager.
Easthampton,	Hampton Co-operative,	W. A. Wright, superintendent.
Egremont (P. O. North Egremont).	Egremont Co-operative,	H. O. Harrington, manager.
Heath,	Cold Spring,	I. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery Company.	W. C. Solomon, manager.
Lee,	Lee Co-operative,	P. A. Agnew, manager.
Leominster,	Leominster,	G. S. Wass & Co.
Montague,	Montague Creamery,	F. A. Rist, manager.
Monterey,	Berkshire Hills Co-operative.	D. A. Campbell, manager.
New Salem (P. O. Millington).	New Salem Co-operative,	W. A. Moore, superintendent.
North Brookfield,	North Brookfield,	H. A. Richardson.
Northfield,	Northfield Co-operative,	L. R. Smith, superintendent.
Orange (P. O. North Orange).	Orange Co-operative,	C. E. Dunbar, manager.
Sandisfield (P. O. New Boston).	Berkshire Co-operative,	L. A. Bonnel, manager.
Shelburne,	Shelburne,	C. Williams, manager.
Uxbridge,	Farnum's Dairy,	Geo. Farnum.
Warren,	Worcester County,	Gustal Hallberg, manager.
Westfield,	Wyben Spring Co-operative.	C. H. Wolcott, manager.
West Newbury,	West Newbury Co-operative.	R. S. Brown, manager.
Williamsburg,	Williamsburg Co-operative,	D. T. Clark, manager.
Worthington (P. O. Ringville).	Worthington Co-operative,	M. R. Bates, superintendent.

2. *Milk Depots.*

Location.	Name.	President or Manager.
Beverly, ...	Cherry Hill Farm, . .	Henry Fielden, superintendent.
Boston (P. O. Roxbury), .	Alden Bros., ...	
Boston (P. O. Charlestown).	Boston Dairy Company, .	W. A. Graustein, president.
Boston (P. O. Charlestown).	H. P. Hood & Sons, . .	
Boston, ...	Walker-Gordon Laboratory.	R. A. Hubbard, manager.
Boston (P. O. Charlestown).	D. Whiting & Sons, . .	Geo. Whiting, manager.
Cambridge, ...	C. Brigham Company, .	J. R. Blair, superintendent.
Conway, ...	Boston Dairy Company, .	C. P. Hassel, manager.
Everett, ...	N. E. Dairy Company, .	F. H. Adams, manager.
Framingham (P. O. South Framingham).	Echo Farm Dairy, . .	J. Turner.
Fitchburg, ...	Fitchburg Creamery, . .	G. S. Learned.
Gardner, ...	Boston Dairy Company, .	W. Fitzsimmons, manager.
Groton, ...	Lawrence Creamery, . .	M. P. Swallow, manager.
Lynn, ...	H. P. Hood & Sons, . .	E. W. Park, manager.
Marlborough, . . .	Este's Creamery, . .	F. S. Este.
North Adams, . . .	W. H. Freeman Company,	W. G. McKay, manager.
Sheffield, ...	Willow Brook Dairy, . .	G. W. Patterson, manager.
Southborough, . . .	Deerfoot Farm Dairy, .	S. H. Howes, superintendent.
Springfield, ...	Springfield Co-operative Milk Association.	F. B. Allen, manager.
Springfield, ...	Tait Bros., ...	H. J. Tait, president.
West Stockbridge, . .	F. D. Shove Creamery, .	C. E. Hardy, manager.
Worcester, ...	Wachusett Creamery, .	E. H. Thayer & Co.
Worcester, ...	Worcester Dairy Company,	G. R. Bryant, manager.

The Testing of Pure-bred Cows.

Breeders of Jersey and Guernsey cows in Massachusetts continue to make yearly milk and butter fat tests of their stock under the rules of their respective national cattle clubs. This division of the station assists in the work by furnishing reputable parties who monthly visit each herd where tests are in progress, weigh each milking during twenty-four or forty-eight hours, and test the same by the Babcock for the butter fat percentage. The cost of such work consists of the tester's time at $2 to $2.50 a day, together with his travelling expenses, board and breakage. The station receives its pay from the Jersey or Guernsey clubs. There have been completed during the year 24 Guernsey and 38 Jersey records, and at present there are 8 Guernseys and 32 Jerseys undergoing yearly tests. Tests are likewise being conducted for the National Holstein-Friesian Association. These are mostly seven-day tests for milk and butter fat. Occasionally breeders test their animals for thirty and even ninety days. The test of the Holstein cow De Kol Creamelle No. 59158, belonging to Mr. D. W. Field, which yielded in one hundred days 10,017 pounds of milk containing 284.088 pounds of fat, was made by Mr. A. D. Guiel of this station. During the year 72 Holsteins have been tested, requiring the services of five men at different times during the year. The station does not publish the results obtained, but reports the same to the several cattle clubs, and keeps a duplicate record on file. It must be understood that the making of appointments for tests, the furnishing of apparatus, the securing of the necessary competent men and the verifying of the results require considerable time and thought, and necessarily interfere with the other work of this department.

Work completed.

Molasses. — There has been completed a repeated experiment with Porto Rico molasses as a food for dairy stock. Digestion tests have likewise been made, in which it is shown that molasses depresses the digestibility of the other foods with which it is fed. The entire results will be published in bulletin form. Porto Rico molasses contains some 1,100 to 1,150 pounds of digestible matter to the ton, and has about 80 per cent. of the nutritive value of corn meal.

Digestion Experiments with Sheep. — A large number of digestion experiments have been completed with sheep, and are published as Part II. of this report. Among the feeds tested may be mentioned sorghum fodder, Green Diamond sugar feed, different amounts of molasses, red and white wheats and feed barley.

The Physiological and Economical Value of Protein in Milk Secretion. — Three experiments have been completed concerning the protein requirements of dairy cows, and it is intended to publish the results in the next annual report. It was not possible to collate the data and prepare the same for publication in time for the present report.

Work in Progress.

Alfalfa Meal. — An experiment is at present in progress to study the value of alfalfa meal as a substitute for wheat bran in milk production. It is understood to be the intention of feed jobbers in the near future to place alfalfa meal upon the market in liberal quantities as a competitor of bran, claiming it to be equal in feeding value and superior in its effect upon the general health and condition of the animal. The indications are that these claims cannot be fully substantiated.

The Effect of Molasses upon the Digestibility of Other Feed Stuffs. — German investigators have long since established the fact that the addition of considerable quantities of starch, sugar and roots depresses the digestibility of the other feeds entering into the composition of the ration. In our previous studies with Porto Rico molasses, as published elsewhere in this report, it has been shown that when molasses constituted some 25 per cent. of the dry matter of the ration, a depression of some 15 per cent. was caused in the digestibility of the latter. Other experiments are now in progress to note if smaller quantities of molasses (10 per cent. of the dry matter of the total ration) will cause relatively as large a depression as twice and thrice that amount.

The Digestibility of Proprietary Grain Rations. — Numerous grain mixtures are now upon the market as ready rations for dairy stock. The station is ascertaining the composition and particularly the digestibility of these rations as compared with home mixtures that the dairymen can prepare by purchasing the high-grade concentrates to be had in all local markets. It is believed that most of these proprietary mixtures are not as economical nor as efficient for milk production as the home mixtures.

Early Amber Sorghum. — The station has continued its observations with this plant as a summer forage crop. Different seedsmen report anywhere from 50 to 100 pounds of seed to be necessary for an acre when sown broadcast. Three twentieth-acre plots were fertilized alike, and the sorghum sown broadcast at the rate of 100, 80 and 60 pounds to the acre. The yields were nearly identical in each case, being at the rate of 20 tons of green material to the acre (harvested September 3). On another twentieth-acre plot the seed was drilled in at the rate of 15 pounds to the acre, and a yield of 19 tons to the acre was secured. This plot, however, was very weedy, and it was not possible to separate the weeds from the sorghum before weighing the crop. It is evident that when sown broadcast (which appeared to be the most economical way for forage purposes) much less seed is required to the acre than is ordinarily recommended. It is intended to repeat these trials with smaller quantities of seed.

Alfalfa. — Observations have been continued on alfalfa as a forage crop. A small piece seeded in the spring of 1905 came through the winter in good condition, and yielded three crops the present season, aggregating 3.65 tons of hay to the acre (figured at 15 per cent. moisture). Cuttings were made June 25, August 3 and September 2. A growth of six or more inches has been allowed to remain as a mulch during the winter.

A second piece, one-sixth of an acre in area, on which alfalfa had been for two years previously, but which had run out, was plowed in the spring of 1906, manured at the rate of 6 cords to the acre, limed with burnt lime at the rate of 1 ton to the acre, a fine seed bed made, and seeded with seed procured from F. E. Dawley, Fayetteville, N. Y. (locally known as Stillwell seed), and a light seeding of oats (¾ bushel to the acre). The seed came up well, and the combined alfalfa and oats were cut during July for forage. A second cutting was made in September. A third growth of six inches has been left as a mulch. It remains to be seen if this piece as well as the other above mentioned will withstand the present winter, and continue to grow without being replaced by clover and grasses. A fuller report will be made later.

Leaming v. Pride of the North Corn. — The comparative values of these two standard varieties are being studied, to ascertain if one has any particular advantage over the other for grain and silage purposes. Accurate determinations of composition and total yields, as well as of composition and yields of stalk, leaves, husks, grain and cob, have been made. The digestibility of the two varieties has also been determined. The experiment will be repeated if necessary during the season of 1907, and the completed data published as soon as possible thereafter.

Clover. — Clover was seeded together with peas and oats, barnyard millet and sorghum the present season, to see if it would not develop after these crops had been removed for soiling. If such were the case, it would save plowing and replanting, and the ground would be immediately occupied by another valuable forage crop. The clover came up well in all cases, but naturally was outstripped by the more rapidly growing annuals. After the three seedings of peas and oats had been successively cut, the clover began to grow; but a considerable growth of weeds and wild grasses also appeared, so that the heavy cutting which was made about the middle of September contained rather more grass than clover. It is possible that the clover will come in well in the spring. The millet and the sorghum grew so dense that the clover was nearly all killed out, hence it did not appear practicable to attempt its growth with such forage crops.

Changes in Staff.

Mr. S. R. Parker, who was employed for two years as dairy tester, resigned June 1, to accept a position as superintendent of agriculture at the Kamehameha Schools, Honolulu, H. T. His place was temporarily filled by the appointment of Mr. J. G. Cook, and later by Mr. H. A. Parsons, who at present fills the position most acceptably. On August 1 Mr. Cook resigned, to take the position of superintendent of the farm connected with the State Asylum for the Insane at Northampton. Mr. A. C. Whittier, who so acceptably filled the position of assistant chemist during one year, severed his connection with this division July 1, to accept a similar and more lucrative position with the Maine Experiment Station. This position was filled by the appointment of Mr. L. S. Walker, a graduate of the college in 1905. Mr. F. G. Helyar, inspector of feeds and of Babcock machines, resigned October 1, to take charge of the agricultural department connected with Mt. Hermon School, Northfield, Mass. Mr. W. K. Hepburn has been appointed to succeed him. While the writer is always pleased to see the young men connected with this division called to more responsible positions, it must be acknowledged that such changes seriously interfere with the work of the station. As a rule, it is believed it would be better economy to pay larger salaries, and retain the services of those who have proved themselves efficient workers.

PART II. — WORK IN ANIMAL NUTRITION.

J. B. LINDSEY, E. B. HOLLAND AND P. H. SMITH.

THE DIGESTIBILITY OF CATTLE FOODS.

The digestion experiments herein reported were made during the autumn, winter and early spring of 1904–05 and 1905–06, and are known as Series X and XI. The usual method was employed, an illustrated description of which is to be found in the eleventh report of the Massachusetts Experiment Station. The full data are here presented, with the exception of the daily production of manure and the daily water consumption, in which cases, to economize space, averages only are given. The periods extended over fourteen days, the first seven of which were preliminary, collection of fæces being made during the last seven. Ten grams of salt were given each sheep daily, with water *ad libitum*. Three lots of Southdown wethers were employed in the several trials, and were known as the Old Sheep, Young Sheep, and Paige Sheep. The former were fully six years of age, and the latter two lots three to four years.

SERIES X.

The results obtained in this series on the whole can be pronounced satisfactory. In periods I., II., III. and IV. the same hay was used as in the year preceding, and the digestion coefficients employed in calculating the results of these several periods were as follows:[1] —

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[1] See also seventeenth report of this station, page 46.

	Old Sheep II. and III.	Young Sheep I.	Young Sheep II.	Young Sheep III.
Dry matter,	58.50	49.89	54.34	51.53
Ash,	22.00	13.86	22.60	16.55
Protein,	42.50	37.37	37.72	36.36
Fiber,	61.00	49.98	55.85	53.13
Nitrogen-free extract,	64.00	56.29	59.77	57.02
Fat,	46.50	38.24	44.19	36.97

In all of the remaining periods a new lot of hay was used, and the following coefficients were employed, being the average of those secured for each group of sheep: —

	Old Sheep.	Young Sheep.	Paige Sheep.
Dry matter,	60.72	57.07	57.98
Ash,	45.50	43.64	40.52
Protein,	53.69	47.37	53.61
Fiber,	63.79	57.55	59.06
Nitrogen-free extract,	63.08	61.11	61.41
Fat,	50.24	51.71	47.76

The composition of the old hay used in the first four periods was taken to be the same as was shown by the two analyses made in the preceding year. The composition of the new hay represents the average of three analyses. The average of the several analyses follows: —

	Old Hay, **1903-04.**	New Hay, **1904-05.**
Ash,	6.44	8.20
Protein,	6.24	8.69
Fiber,	32.48	32.14
Nitrogen-free extract,	52.70	48.56
Fat,	2.14	2.41

Composition of Feed Stuffs (Per Cent.).

[Dry Matter.]

FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Soy bean fodder,	9.17	21.69	27.83	37.75	3.56
Blomo feed,	10.73	17.23	13.14	58.28	0.62
Malt sprouts,	6.58	28.65	15.29	47.70	1.78
Sucrene dairy feed,	6.17	18.48	14.11	56.95	4.29
Holstein sugar feed,	7.31	13.73	10.88	65.14	2.94
Macon sugar feed,	6.83	15.16	10.20	66.11	1.70
Hominy feed,	2.78	11.59	5.28	71.54	8.81
Buckwheat middlings,	4.82	28.23	8.95	50.61	7.39
Oat middlings,	2.61	17.72	2.56	69.47	7.64
Eureka silage corn stover,	6.96	8.00	36.49	47.16	1.39
Waste Eureka silage corn stover, Sheep II.,	8.50	6.71	41.89	41.89	1.01
Waste Eureka silage corn stover, Sheep III.,	7.45	6.02	42.84	42.48	1.21
Pride of the North corn stover,	6.77	7.23	34.45	50.01	1.54
Waste Pride of the North corn stover, Sheep II.	7.64	4.27	40.94	45.65	1.50
Waste Pride of the North corn stover, Sheep III.	6.88	3.76	40.74	47.14	1.48
Digestion hay fed to Paige Sheep IV.,	7.82	8.56	32.35	48.75	2.52
Digestion hay fed to Young Sheep,	8.43	8.70	32.17	48.33	2.37
Digestion hay fed to Old Sheep and Paige Sheep V.	8.35	8.80	31.89	48.62	2.34
Average for digestion hay (three trials),	8.20	8.69	32.14	48.56	2.41

Composition of Fæces (Per Cent.).

[Dry Matter.]

Old Sheep II.

Periods.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
II.,	Blomo feed,	15.41	11.93	25.59	44.81	2.26
IV.,	Sucrene feed,	11.92	12.32	26.50	47.05	2.21
V.,	Eureka silage corn stover,	7.96	8.75	34.10	48.16	1.03
VII.,	Pride of the North corn stover,	9.54	8.81	30.27	50.17	1.21
IX.,	Digestion hay,	11.48	10.22	29.56	45.71	3.03
XI.,	Macon sugar feed,	13.17	12.90	27.09	44.26	2.58

Composition of Fæces (Per Cent.) — Concluded.

Old Sheep III.

Periods.	FEEDS.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
II.,	Blomo feed, ...	16.33	13.38	23.99	43.92	2.38
IV.,	Sucrene feed, ...	12.53	13.04	24.84	47.34	2.25
V.,	Eureka silage corn stover, . . .	8.67	9.73	30.51	50.05	1.04
VII.,	Pride of the North corn stover, . .	10.62	9.41	27.95	50.84	1.18
IX.,	Digestion hay, ...	11.68	10.52	29.23	45.67	2.90
XI.,	Macon sugar feed, ...	13.57	13.75	26.40	43.90	2.38
	Young Sheep I.					
I.,	Soy bean fodder, ...	13.22	10.02	36.33	37.43	3.00
III.,	Malt sprouts, ...	12.97	11.19	27.80	45.42	2.62
VIII.,	Digestion hay, ...	10.92	10.26	32.09	44.01	2.72
X.,	Holstein sugar feed, ...	13.10	12.80	28.36	43.50	2.24
XIII.,	Buckwheat middlings, ...	11.52	11.74	32.08	41.79	2.87
	Young Sheep II.					
I.,	Soy bean fodder, ...	13.19	10.36	36.24	37.20	3.01
III.,	Malt sprouts, ...	13.11	11.72	26.74	45.93	2.50
VIII.,	Digestion hay, ...	11.57	11.18	30.46	44.06	2.73
X.,	Holstein sugar feed, ...	13.06	12.80	27.49	44.32	2.33
XIII.,	Buckwheat middlings, ...	11.23	12.84	31.65	41.58	2.70
	Young Sheep III.					
I.,	Soy bean fodder, ...	13.40	9.72	36.36	37.64	2.88
III.,	Malt sprouts, ...	12.93	11.20	28.13	45.28	2.46
VIII.,	Digestion hay, ...	10.75	10.60	32.81	43.29	2.55
X.,	Holstein sugar feed, ...	11.65	11.42	30.23	44.41	2.29
XIII.,	Buckwheat middlings, ...	10.62	11.31	32.98	42.26	2.83
	Paige Sheep IV.					
VI.,	Digestion hay, ...	11.61	9.90	30.66	44.91	2.92
XII.,	Hominy feed, ...	12.17	12.75	27.63	43.68	3.77
XIV.,	Oat middlings, ...	12.52	12.52	28.81	42.82	3.33
	Paige Sheep V.					
IX.,	Digestion hay, ...	11.23	9.24	31.93	44.49	3.11
XII.,	Hominy feed, ...	11.02	11.69	28.64	44.93	3.72
XIV.,	Oat middlings, ...	11.81	12.39	29.35	43.31	3.14

Dry Matter Determinations made at Time of weighing out the Different Foods, and Dry Matter in Manure excreted, determined from Air-dry Fæces (Per Cent.).

Old Sheep II.

Periods.	English Hay.	Blomo Feed.	Sucrene Feed.	Eureka Silage Corn Stover.	Pride of the North Corn Stover.	Macon Sugar Feed.	Waste.	Fæces.
II., . .	87.70	81.77	–	–	–	–	–	91.35
IV., . .	87.35	–	86.87	–	–	–	–	93.61
V., . .	–	–	–	37.11	–	–	43.15	94.16
VII., . .	–	–	–	–	81.87	–	88.89	94.22
IX., . .	89.77	–	–	–	–	–	–	95.03
XI., . .	90.30	–	–	–	–	94.45	–	93.96

Old Sheep III.

II., . .	87.70	81.77	–	–	–	–	–	91.42
IV., . .	87.35	–	86.87	–	–	–	–	93.64
V., . .	–	–	–	37.11	–	–	45.63	93.96
VII., . .	–	–	–	–	81.87	–	85.63	94.03
IX., . .	89.77	–	–	–	–	–	–	94.84
XI., . .	90.30	–	–	–	–	94.45	–	93.57

Dry Matter Determinations, etc. — Continued.

Young Sheep I.

Periods.	English Hay.	Soy Bean Fodder.	Malt Sprouts.	Holstein Sugar Feed.	Buckwheat Middlings.	Waste.	Fæces.
I., . . .	88.40	20.64	–	–	–	–	89.51
III., . . .	88.02	–	84.68	–	–	–	93.09
VIII., . . .	88.52	–	–	–	–	–	93.97
X., . . .	89.90	–	–	91.66	–	–	94.15
XIII., . . .	90.55	–	–	–	90.74	–	94.40

Young Sheep II.

I., . . .	88.40	20.64	–	–	–	–	89.44
III., . . .	88.02	–	84.68	–	–	–	92.93
VIII., . . .	88.52	–	–	–	–	–	94.01
X., . . .	89.90	–	–	91.66	–	–	94.19
XIII., . . .	90.55	–	–	–	90.74	–	93.91

Dry Matter Determinations, etc. — Continued.

Young Sheep III.

Periods.	English Hay.	Soy Bean Fodder.	Malt Sprouts.	Holstein Sugar Feed.	Buckwheat Middlings.	Waste.	Fæces.
I., ...	88.40	20.64	–	–	–	–	89.54
IV., ...	88.02	–	84.68	–	–	–	93.13
VIII., ...	88.52	–	–	–	–	–	93.91
X., ...	89.90	–	–	91.66	–	–	94.35
XIII., ...	90.55	–	–	–	90.74	–	94.28

Dry Matter Determinations, etc. — Concluded.

Paige Sheep IV.

Periods.	English Hay.	Hominy Feed.	Oat Middlings.	Waste.	Fæces.
VI., ...	88.35	–	–	–	93.35
XII., ...	90.62	90.94	–	–	94.09
XIV., ...	90.45	–	91.07	–	93.73

Paige Sheep V.

Periods.	English Hay.	Hominy Feed.	Oat Middlings.	Waste.	Fæces.
IX., ...	89.77	–	–	–	95.08
XII., ...	90.62	90.94	–	–	94.20
XIV., ...	90.45	–	91.07	–	93.52

Average Daily Amount of Manure excreted and Water drank (Grams).

Old Sheep II.

Periods.	Character of Ration.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
II.,	Blomo feed, ...	671	32.80	1,306
IV.,	Sucrene feed, ...	751	31.15	1,144
V.,	Eureka silage corn stover, ...	765	31.07	lost.
VII.,	Pride of the North corn stover, . . .	1,058	37.63	1,667
IX.,	Digestion hay, ...	775	32.54	1,643
XI.,	Macon sugar feed, ...	739	31.99	1,592

Old Sheep III.

Periods.	Character of Ration.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
II.,	Blomo feed, ...	675	30.83	1,578
IV.,	Sucrene feed, ...	867	32.31	1,606
V.,	Eureka silage corn stover, ...	921	28.91	804
VII.,	Pride of the North corn stover, . . .	1,123	34.40	2,500
IX.,	Digestion hay, ...	1,107	34.30	2,430
XI.,	Macon sugar feed, ...	1,155	31.21	2,227

Average Daily Amount of Manure excreted and Water drank (Grams) — Concluded.

Young Sheep I.

Periods.	CHARACTER OF RATION.	Manure excreted daily.	Sample Air Dry.	Water drank daily.
I.,	Soy bean fodder, ...	615	30.28	188
III.,	Malt sprouts, ...	870	30.43	1,392
VIII.,	Digestion hay, ...	961	33.17	1,693
X.,	Holstein sugar feed, ...	1,008	29.21	1,608
XIII.,	Buckwheat middlings, ...	743	28.62	1,689

Young Sheep II.

I.,	Soy bean fodder, ...	573	30.70	1,169
III.,	Malt sprouts, ...	746	30.48	2,334
VIII.,	Digestion hay, ...	984	30.86	2,471
X.,	Holstein sugar feed, ...	868	28.04	2,249
XIII.,	Buckwheat middlings, ...	882	27.91	2,410

Young Sheep III.

I.,	Soy bean fodder, ...	638	32.68	1,666
III.,	Malt sprouts, ...	791	30.86	2,486
VIII.,	Digestion hay, ...	1,152	33.02	2,500
X.,	Holstein sugar feed, ...	743	29.30	2,335
XIII.,	Buckwheat middlings, ...	699	29.59	2,486

Paige Sheep IV.

VI.,	Digestion hay, ...	678	32.15	1,138
IX.,	Digestion hay, ...	–	–	–
XII.,	Hominy feed, ...	596	25.37	1,901
XIV.,	Oat middlings, ...	598	24.85	1,924

Paige Sheep V.

VI.,	Digestion hay, ...	–	–	–
IX.,	Digestion hay, ...	699	31.41	1,924
XII.,	Hominy feed, ...	630	26.31	1,666
XIV.,	Oat middlings, ...	661	25.85	1,814

Weights of Animals at Beginning and End of Period (Pounds).

Old Sheep II.

Periods.	CHARACTER OF RATION.	Beginning.	End.
II.,	Blomo feed,	154.75	152.00
IV.,	Sucrene feed,	156.50	157.75
V.,	Eureka silage corn stover,	156.50	154.00
VII.,	Pride of the North corn stover,	154.50	157.00
IX.,	Digestion hay,	158.25	157.25
XI.,	Macon sugar feed,	160.00	157.75

Old Sheep III.

II.,	Blomo feed,	163.00	160.00
IV.,	Sucrene feed,	164.25	162.25
V.,	Eureka silage corn stover,	163.25	163.00
VII.,	Pride of the North corn stover,	164.50	161.00
IX.,	Digestion hay,	167.00	165.25
XI.,	Macon sugar feed,	164.00	164.25

Young Sheep I.

I.,	Soy bean fodder,	101.50	99.75
III.,	Malt sprouts,	109.50	109.75
VIII.,	Digestion hay,	120.00	116.00
X.,	Holstein sugar feed,	116.00	114.25
XIII.,	Buckwheat middlings,	113.00	114.00

Young Sheep II.

I.,	Soy bean fodder,	102.50	101.00
III.,	Malt sprouts,	110.50	108.50
VIII.,	Digestion hay,	122.00	120.00
X.,	Holstein sugar feed,	115.75	116.00
XIII.,	Buckwheat middlings,	115.25	116.00

Young Sheep III.

I.,	Soy bean fodder,	97.00	95.75
III.,	Malt sprouts,	102.25	101.50
VIII.,	Digestion hay,	111.00	107.50
X.,	Holstein sugar feed,	106.00	106.00
XIII.,	Buckwheat middlings,	106.50	106.50

Weights of Animals, etc. — Concluded.

Paige Sheep IV.

Periods.	Character of Ration.	Beginning.	End.
VI.,	Digestion hay, ...	156.00	155.50
IX.,	Digestion hay, ...	–	–
XII.,	Hominy feed, ...	154.50	152.00
XIV.,	Oat middlings, ...	155.50	155.00

Paige Sheep V.

VI.,	Digestion hay, ...	–	–
IX.,	Digestion hay, ...	133.25	137.75
XII.,	Hominy feed, ...	140.00	140.25
XIV.,	Oat middlings, ...	141.00	143.25

Period I.

Young Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
350 grams English hay fed, ...	309.40	19.93	19.31	100.49	163.05	6.62
1,800 grains soy bean fodder fed, . .	371.52	34.07	80.58	103.39	140.25	13.23
Amount consumed, ...	680.92	54.00	99.89	203.88	303.30	19.85
302.84 grams manure excreted, . .	271.07	35.84	27.16	98.48	101.46	8.13
Grams digested, ...	409.85	18.16	72.73	105.40	201.84	11.72
Minus hay digested, ...	154.36	2.76	7.22	50.22	91.78	2.55
Soy bean fodder digested, . . .	255.49	15.40	65.51	55.18	110.06	9.17
Per cent. digested, ...	68.77	45.20	81.30	53.37	78.47	69.31

Young Sheep II.

Amount consumed as above, ...	680.92	54.00	99.89	203.88	303.30	19.85
307.13 grams manure excreted, . .	274.70	36.23	28.46	99.55	102.19	8.27
Grams digested, ...	406.22	17.77	71.43	104.33	201.11	11.58
Minus hay digested, ...	168.13	4.50	7.28	56.12	97.45	2.93
Soy bean fodder digested, . . .	238.09	13.27	64.15	48.21	103.66	8.65
Per cent. digested, ...	64.09	38.95	79.61	46.63	73.91	65.38

Period I. — Concluded.

Young Sheep III.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	680.92	54.00	99.89	203.88	303.30	19.85
326.78 grams manure excreted,	292.60	39.21	28.44	106.39	110.13	8.43
Grams digested,	388.32	14.79	71.45	97.49	193.17	11.42
Minus hay digested,	159.43	3.30	7.08	53.39	92.97	2.45
Soy bean fodder digested,	228.89	11.49	64.37	44.10	100.20	8.97
Per cent. digested,	61.61	33.72	79.88	42.65	71.44	67.80
Average per cent. three sheep digested,	64.82	39.29	80.26	47.55	74.61	67.50

Average nutritive ratio of rations for three sheep, 1:4.54.

Period II.

Old Sheep II.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
500 grams English hay fed,	438.50	28.24	27.36	142.42	231.09	9.38
400 grams Blomo feed fed,	327.08	35.10	56.36	42.98	190.62	2.03
Amount consumed,	765.58	63.34	83.72	185.40	421.71	11.41
328.04 grams manure excreted,	299.66	46.18	35.75	76.68	134.28	6.77
Grams digested,	465.92	17.16	47.97	108.72	287.43	4.64
Minus hay digested,	256.52	6.21	11.63	86.88	147.90	4.36
Blomo feed digested,	209.40	10.95	36.34	21.84	139.53	.28
Per cent. digested,	64.02	31.20	64.48	50.81	73.20	13.79

Old Sheep III.

Amount consumed as above,	765.58	63.34	83.72	185.40	421.71	11.41
308.33 grams manure excreted,	281.88	46.03	37.72	67.62	123.80	6.71
Grams digested,	483.70	17.31	46.00	117.78	297.91	4.70
Minus hay digested,	256.52	6.21	11.63	86.88	147.90	4.36
Blomo feed digested,	227.18	11.10	34.37	30.90	150.01	.34
Per cent. digested,	69.46	31.62	60.98	71.89	78.70	16.75
Average per cent. two sheep digested,	66.74	31.41	62.73	61.35	75.95	15.27

Average nutritive ratio of rations for two sheep, 1:8.86.

Period III.

Young Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	528.12	34.01	32.95	171.53	278.32	11.30
200 grams malt sprouts fed,	169.36	11.14	48.52	25.90	80.78	3.01
Amount consumed,	697.48	45.15	81.47	197.43	359.10	14.31
304.24 grams manure excreted,	283.22	36.73	31.69	78.74	128.64	7.42
Grams digested,	414.26	8.42	49.78	118.69	230.46	6.89
Minus hay digested,	263.48	4.71	12.31	85.73	156.67	4.32
Malt sprouts digested,	150.78	3.71	37.47	32.96	73.79	2.57
Per cent. digested,	89.03	33.30	77.23	100+	91.35	85.38

Young Sheep II.

Amount consumed as above,	697.48	45.15	81.47	197.43	359.10	14.31
304.81 grams manure excreted,	283.26	37.14	33.20	75.74	130.10	7.08
Grams digested,	414.22	8.01	48.27	121.69	229.00	7.23
Minus hay digested,	286.98	7.69	12.43	95.80	166.35	4.99
Malt sprouts digested,	127.24	.32	35.84	25.89	62.65	2.24
Per cent. digested,	75.13	2.87	73.87	100.00	77.56	74.42

Young Sheep III.

Amount consumed as above,	697.48	45.15	81.47	197.43	359.10	14.31
308.60 grams manure excreted,	287.40	37.16	32.19	80.85	130.13	7.07
Grams digested,	410.08	7.99	49.28	116.56	228.97	7.24
Minus hay digested,	272.14	5.63	12.08	91.13	158.70	4.18
Malt sprouts digested,	137.94	2.36	37.20	25.45	70.27	3.06
Per cent. digested,	81.45	21.18	76.67	98.26	86.99	100+
Average per cent. three sheep digested,	81.87	19.12	75.92	99.42	85.30	86.60

Average nutritive ratio of rations for three sheep, 1 : 7.42.

Period IV.

Old Sheep II.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	524.10	33.75	32.70	170.23	276.20	11.22
300 grams Sucrene dairy feed fed,	260.61	16.08	48.16	36.77	148.42	11.18
Amount consumed,	784.71	49.83	80.86	207.00	424.62	22.40
311.47 grams manure excreted,	291.57	34.76	35.92	77.27	137.18	6.44
Grams digested,	493.14	15.07	44.94	129.73	287.44	15.96
Minus hay digested,	306.60	7.43	13.90	103.84	176.77	5.22
Sucrene dairy feed digested,	186.54	7.64	31.04	25.89	110.67	10.74
Per cent. digested,	71.58	47.51	64.45	70.41	74.57	96.06

Old Sheep III.

Amount consumed as above,	784.71	49.83	80.86	207.00	424.62	22.40
323.07 grams manure excreted,	302.52	37.91	39.45	75.15	143.21	6.81
Grams digested,	482.19	11.92	41.41	131.85	281.41	15.59
Minus hay digested,	306.60	7.43	13.90	103.84	176.77	5.22
Sucrene dairy feed digested,	175.59	4.49	27.51	27.01	104.64	10.37
Per cent. digested,	67.38	27.92	57.12	73.46	70.50	92.75
Average per cent. two sheep digested,	69.48	37.72	60.79	71.94	72.54	94.41

Average nutritive ratio of rations for two sheep, 1:10.4.

Period V.

Old Sheep II.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,800 grams Eureka silage corn stover,	667.98	46.49	53.44	243.75	315.02	9.28
Minus 89 grams waste,	38.40	3.26	2.58	16.09	16.09	.38
Amount consumed,	629.58	43.23	50.86	227.66	298.93	8.90
310.74 grams manure excreted,	292.59	23.29	25.60	99.77	140.91	3.01
Grams digested,	336.99	19.94	25.26	129.89	158.02	5.89
Per cent. digested,	53.53	46.13	49.67	56.18	52.86	66.18

Period V. — Concluded.

Old Sheep III.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,800 grams Eureka silage corn stover,	667.98	46.49	53.44	243.75	315.02	9.28
Minus 133.20 grams waste, . . .	60.78	4.53	3.66	26.04	25.82	0.74
Amount consumed, ...	607.20	41.96	49.78	217.71	289.20	8.54
289.07 grams manure excreted, . .	271.61	23.55	26.43	82.87	135.94	2.82
Grams digested, ...	335.59	18.41	23.35	134.84	153.26	5.72
Per cent. digested, ...	55.27	43.88	46.91	61.94	52.99	66.98
Average per cent. two sheep digested,	54.40	45.01	48.29	59.06	52.93	66.58

Average nutritive ratio of rations for two sheep, 1: 12.3.

Period VI.

Paige Sheep IV.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed, . . .	706.80	55.27	60.50	228.65	344.57	17.81
321.50 grams manure excreted, . .	300.12	34.84	29.71	92.02	134.78	8.76
Grams digested, ...	406.68	20.43	30.79	136.63	209.79	9.05
Per cent. digested, ...	57.54	36.96	50.89	59.76	60.88	50.81

Nutritive ratio of ration, 1: 11.9.

Period VII.

Old Sheep II.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,000 grams Pride of the North corn stover.	818.70	55.43	59.19	282.04	409.43	12.61
Minus 74.64 grams waste, . . .	66.35	5.07	2.83	27.16	30.29	1.00
Amount consumed, ...	752.35	50.36	56.36	254.88	379.14	11.61
376.31 grams manure excreted, . .	354.56	33.83	31.24	107.33	177.88	4.29
Grams digested, ...	397.79	16.53	25.12	147.55	201.26	7.32
Per cent. digested, ...	52.87	32.82	44.57	57.89	53.08	63.05

Period VII. — Concluded.

Old Sheep III.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
1,000 grams Pride of the North corn stover.	818.70	55.43	59.19	282.04	409.43	12.61
Minus 115.45 grams waste,	98.86	6.80	3.72	40.28	46.60	1.46
Amount consumed,	719.84	48.63	55.47	241.76	362.83	11.15
344.01 grams manure excreted,	323.47	34.35	30.44	90.41	164.45	3.82
Grams digested,	396.37	14.28	25.03	151.35	198.38	7.33
Per cent. digested,	55.06	29.36	45.12	62.60	54.68	65.75
Average per cent. two sheep digested,	53.97	31.09	44.85	60.25	53.88	64.40

Average nutritive ratio of rations for two sheep, 1: 14.6.

Period VIII.

Young Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	708.16	59.70	61.61	227.82	342.25	16.78
331.74 grams manure excreted,	311.74	34.04	31.98	100.04	137.20	8.48
Grams digested,	396.42	25.66	29.63	127.78	205.05	8.30
Per cent. digested,	55.98	42.98	48.09	56.09	59.91	49.46

Young Sheep II.

800 grams English hay fed,	708.16	59.70	61.61	227.82	342.25	16.78
308.60 grams manure excreted,	290.11	33.57	32.43	88.37	127.82	7.92
Grams digested,	418.05	26.13	29.18	139.45	214.43	8.86
Per cent. digested,	59.03	43.77	47.36	61.21	62.65	52.80

Young Sheep III.

800 grams English hay fed,	708.16	59.70	61.61	227.82	342.25	16.78
330.18 grams manure excreted,	310.07	33.33	32.87	101.73	134.23	7.91
Grams digested,	398.09	26.37	28.74	126.09	208.02	8.87
Per cent. digested,	56.21	44.17	46.65	55.35	60.78	52.86
Average per cent. three sheep digested,	57.07	43.64	47.37	57.55	61.11	51.71

Average nutritive ratio of rations for three sheep, 1: 12.3.

Period IX.

Old Sheep II.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams English hay fed, . . .	807.93	67.46	71.10	257.65	392.82	18.91
325.43 grams manure excreted, . .	309.26	35.50	31.61	91.42	141.36	9.37
Grams digested, ...	498.67	31.96	39.49	166.23	251.46	9.54
Per cent. digested, ...	61.72	47.36	55.54	64.52	64.01	50.45

Old Sheep III.

900 grams English hay fed, . . .	807.93	67.46	71.10	257.65	392.82	18.91
343 grams manure excreted, . . .	325.30	38.00	34.22	95.09	148.56	9.43
Grams digested, ...	482.63	29.46	36.88	162.56	244.26	9.47
Per cent. digested, ...	59.74	43.67	51.87	63.09	62.18	50.08

Paige Sheep V.

800 grams English hay fed, . . .	718.16	59.97	63.20	229.02	349.17	16.80
314.13 grams manure excreted, . .	298.67	33.54	27.60	95.37	132.88	9.29
Grams digested, ...	419.49	26.43	35.60	133.65	216.29	7.51
Per cent. digested, ...	58.41	44.07	56.33	58.36	61.94	44.70
Average per cent. three sheep digested,	60.73	45.52	53.71	63.81	63.10	50.27

Average nutritive ratio of rations for three sheep, 1:11.3.

Period X.

Young Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
500 grams English hay fed, . . .	449.50	36.86	39.06	144.47	218.28	10.83
300 grams Holstein sugar feed, . .	274.98	20.10	37.75	29.92	179.12	8.08
Amount consumed, ...	724.48	56.96	76.81	174.39	397.40	18.91
292.11 grams manure excreted, . .	275.02	36.03	35.20	78.00	119.63	6.16
Grams digested, ...	449.46	20.93	41.61	96.39	277.77	12.75
Minus hay digested, ...	256.53	16.09	18.50	83.14	133.39	5.60
Holstein sugar feed digested, . .	192.93	4.84	23.11	13.25	144.38	7.15
Per cent. digested, ...	70.16	24.08	61.22	44.28	80.61	88.49

Period X. — Concluded.

Young Sheep II.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	724.48	56.96	76.81	174.39	397.40	18.91
280.41 grams manure excreted,	264.12	34.49	33.81	72.61	117.06	6.15
Grams digested,	460.36	22.47	43.00	101.78	280.34	12.76
Minus hay digested,	256.53	16.09	18.50	83.14	133.39	5.60
Holstein sugar feed digested,	203.83	6.38	24.50	18.64	146.95	7.16
Per cent. digested,	74.13	31.74	64.90	62.30	82.04	88.61

Young Sheep III.

Amount consumed as above,	724.48	56.96	76.81	174.39	397.40	18.91
293.03 grams manure excreted,	276.47	32.21	31.57	83.58	122.78	6.33
Grams digested,	448.01	24.75	45.24	90.81	274.62	12.58
Minus hay digested,	256.53	16.09	18.50	83.14	133.39	5.60
Holstein sugar feed digested,	191.48	8.66	26.74	7.67	141.23	6.98
Per cent. digested,	69.63	43.08	70.83	25.64	78.85	86.39
Average per cent. three sheep digested,	71.31	32.97	65.65	44.07	80.50	87.83

Average nutritive ratio of rations for three sheep, 1:9.3.

Period XI.

Old Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	541.80	44.43	47.08	174.13	263.10	13.06
300 grams Macon sugar feed,	283.35	19.35	42.96	28.90	187.32	4.82
Amount consumed,	825.15	63.78	90.04	203.03	450.42	17.88
319.90 grams manure excreted,	300.58	39.59	38.77	81.43	133.04	7.75
Grams digested,	524.57	24.19	51.27	121.60	317.38	10.13
Minus hay digested,	328.98	20.22	25.28	111.08	165.96	6.56
Macon sugar feed digested,	195.59	3.97	25.99	10.52	151.42	3.57
Per cent. digested,	69.03	20.52	60.50	36.40	80.83	74.07

Period XI. — Concluded.

Old Sheep III.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above, . . .	825.15	63.78	90.04	203.03	450.42	17.88
312.14 grams manure excreted, . .	292.07	39.63	40.16	77.11	128.22	6.95
Grams digested, ...	533.08	24.15	49.88	125.92	322.20	10.93
Minus hay digested, ...	328.98	20.22	25.28	111.08	165.96	6.56
Macon sugar feed digested, . . .	204.10	3.93	24.60	14.84	156.24	4.37
Per cent. digested, ...	72.03	20.31	57.26	51.35	83.41	90.66
Average per cent. two sheep digested,	70.53	20.42	58.88	43.88	82.12	82.37

Average nutritive ratio of rations for two sheep, 1:9.2.

Period XII.

Paige Sheep IV.

DAILY RECORD.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed, . . .	498.41	40.87	43.31	160.19	242.03	12.01
300 grams hominy feed, ...	272.22	7.57	31.55	14.37	194.75	23.98
Amount consumed, ...	770.63	48.44	74.86	174.56	436.78	35.99
253.67 grams manure excreted, . .	238.68	29.05	30.43	65.95	104.26	9.00
Grams digested, ...	531.95	19.39	44.43	108.61	332.52	26.99
Minus hay digested, ...	288.98	16.56	23.22	94.61	148.63	5.74
Hominy feed digested, ...	242.97	2.83	21.21	14.00	183.89	21.25
Per cent. digested, ...	89.26	37.38	67.23	97.43	94.42	88.62

Paige Sheep V.

Amount consumed as above, . . .	770.63	48.44	74.86	174.56	436.78	35.99
263.07 grams manure excreted, . .	247.81	27.31	28.97	70.97	111.34	9.22
Grams digested, ...	522.82	21.13	45.89	103.59	325.44	26.77
Minus hay digested, ...	288.98	16.56	23.22	94.61	148.63	5.74
Hominy feed digested, ...	233.84	4.57	22.67	8.98	176.81	21.03
Per cent. digested, ...	85.90	60.37	71.85	62.49	90.79	87.70
Average per cent. two sheep digested,	87.58	48.88	69.54	79.96	92.61	88.16

Average nutritive ratio of rations for two sheep, 1:10.9.

Period XIII.

Young Sheep I.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	498.03	40.84	43.28	160.07	241.84	12.00
250 grams buckwheat middlings,	226.85	10.93	64.04	20.30	114.81	16.76
Amount consumed,	724.88	51.77	107.32	180.37	356.65	28.76
286.23 grams manure excreted,	270.20	31.13	31.72	86.68	112.92	7.75
Grams digested,	454.68	20.64	75.60	93.69	243.73	21.01
Minus hay digested,	284.23	17.82	20.50	92.12	147.79	6.21
Buckwheat middlings digested,	170.45	2.82	55.10	1.57	95.94	14.80
Per cent. digested,	75.14	25.80	86.04	7.73	83.56	88.31

Young Sheep II.

Amount consumed as above,	724.88	51.77	107.32	180.37	356.65	28.76
279.07 grams manure excreted,	262.07	29.43	33.65	82.95	108.97	7.08
Grams digested,	462.81	22.34	73.67	97.42	247.68	21.68
Minus hay digested,	284.23	17.82	20.50	92.12	147.79	6.21
Buckwheat middlings digested,	178.58	4.52	53.17	5.30	99.89	15.47
Per cent. digested,	78.72	41.35	83.03	26.11	87.00	92.30

Young Sheep III.

Amount consumed as above,	724.88	51.77	107.32	180.37	356.65	28.76
295.90 grams manure excreted,	278.97	29.63	31.55	92.00	117.89	7.89
Grams digested,	445.91	22.14	75.77	88.37	238.76	20.87
Minus hay digested,	284.23	17.82	20.50	92.12	147.79	6.21
Buckwheat middlings digested,	161.68	4.32	55.27	–	90.97	14.66
Per cent. digested,	71.27	39.52	86.31	–	79.24	87.47
Average per cent. three sheep digested,	75.04	35.56	85.13	16.92[1]	83.27	89.36

Average nutritive ratio of rations for three sheep, 1: 5.1.

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[1] Average two sheep.

Period XIV.

Paige Sheep IV.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	497.48	40.79	43.23	159.89	241.58	11.99
300 grams oat middlings,	273.21	7.13	48.41	6.99	189.80	20.87
Amount consumed,	770.69	47.92	91.64	166.88	431.38	32.86
248.47 grams manure excreted,	232.89	29.16	29.16	67.10	99.72	7.76
Grams digested,	537.80	18.76	62.48	99.78	331.66	25.10
Minus hay digested,	288.44	16.53	23.18	94.43	148.35	5.73
Oat middlings digested,	249.36	2.23	39.30	5.35	183.31	19.37
Per cent. digested,	91.27	31.28	81.18	76.54	96.58	92.81

Paige Sheep V.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	770.69	47.92	91.64	166.88	431.38	32.86
258.53 grams manure excreted,	241.78	28.55	29.96	70.96	104.71	7.59
Grams digested,	528.91	19.37	61.68	95.92	326.67	25.27
Minus hay digested,	288.44	16.53	23.18	94.43	148.35	5.73
Oat middlings digested,	240.47	2.84	38.50	1.49	178.32	19.54
Per cent. digested,	88.02	39.83	79.53	21.32	93.95	93.63
Average per cent. two sheep digested,	89.65	35.56	80.36	48.93	95.27	93.22

Average nutritive ratio of rations for two sheep, 1:7.8.

Summary of Coefficients.

Coefficients determined on—	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Soybean fodder,	Young Sheep I.,	68.77	45.20	81.30	53.37	78.47	69.31
	Young Sheep II.,	64.09	38.95	79.61	46.63	73.91	65.38
	Young Sheep III.,	61.61	33.72	79.88	42.65	71.44	67.80
	Average,	64.82	39.29	80.26	47.55	74.61	67.50
Blomo feed,	Old Sheep II.,	64.02	31.20	64.48	50.81	73.20	13.79
	Old Sheep III.,	69.46	31.62	60.98	71.89	78.70	16.75
	Average,	66.74	31.41	62.73	61.35	75.95	15.27
Malt sprouts,	Young Sheep I.,	89.03	33.30	77.23	100+	91.35	85.38
	Young Sheep II.,	75.13	2.87	73.87	100+	77.56	74.42
	Young Sheep III.,	81.45	21.18	76.67	98.26	86.99	100+
	Average,	81.87	19.12	75.92	99.42	85.30	86.60
Sucrene dairy feed.	Old Sheep II.,	71.58	47.51	64.45	70.41	74.57	96.06
	Old Sheep III.,	67.38	27.92	57.12	73.46	70.50	92.75
	Average,	69.48	37.72	60.79	71.94	72.54	94.41

Summary of Coefficients — Concluded.

Coefficients determined on —	Sheep Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Holstein sugar feed.	Young Sheep I., .	70.16	24.08	61.22	44.28	80.61	88.49
	Young Sheep II.,	74.13	31.74	64.90	62.30	82.04	88.61
	Young Sheep III.,	69.63	43.08	70.83	25.64	78.85	86.39
	Average, . .	71.31	32.97	65.65	44.07	80.50	87.83
Macon sugar feed.	Old Sheep II., .	69.03	20.52	60.50	36.40	80.83	74.07
	Old Sheep III., .	72.03	20.31	57.26	51.35	83.41	90.66
	Average, . .	70.53	20.42	58.88	43.88	82.12	82.37
Hominy feed, .	Paige Sheep IV.,	89.26	37.38	67.23	97.43	94.42	88.62
	Paige Sheep V., .	85.90	60.37	71.85	62.49	90.79	87.70
	Average, . .	87.58	48.88	69.54	79.96	92.61	88.16
Buckwheat middlings.	Young Sheep I., .	75.14	25.80	86.04	7.73	83.56	88.31
	Young Sheep II.,	78.72	41.35	83.03	26.11	87.00	92.30
	Young Sheep III.,	71.27	39.52	86.31	–	79.24	87.47
	Average, . .	75.04	35.56	85.13	16.92	83.27	89.36
Oat middlings,	Paige Sheep IV.,	91.27	31.28	81.18	76.54	96.58	92.81
	Paige Sheep V., .	88.02	39.83	79.53	21.32	93.95	93.63
	Average, . .	89.65	35.56	80.36	48.93	95.27	93.22
Eureka silage corn stover.	Old Sheep II., .	53.53	46.13	49.67	56.18	52.86	66.18
	Old Sheep III., .	55.27	43.88	46.91	61.94	52.99	66.98
	Average, . .	54.40	45.01	48.29	59.06	52.93	66.58
Pride of the North corn stover.	Old Sheep II., .	52.87	32.82	44.57	57.89	53.08	63.05
	Old Sheep III., .	55.06	29.36	45.12	62.60	54.68	65.75
	Average, . .	53.97	31.09	44.85	60.25	53.88	64.40
English hay, .	Paige Sheep IV.,	57.54	36.96	50.89	59.76	60.88	50.81
	Paige Sheep V., .	58.41	44.07	56.33	58.36	61.94	44.70
	Average, . .	57.98	40.52	53.61	59.36	61.44	47.76
English hay, .	Young Sheep I., .	55.98	42.98	48.09	56.09	59.91	49.46
	Young Sheep II.,	59.03	43.77	47.36	61.21	62.65	52.80
	Young Sheep III.,	56.21	44.17	46.65	55.35	60.78	52.86
	Average, . .	57.07	43.64	47.37	57.55	61.11	51.71
English hay, .	Old Sheep II., .	61.72	47.36	55.54	64.52	64.01	50.45
	Old Sheep III., .	59.74	43.67	51.87	63.09	62.18	50.08
	Average, . .	60.73	45.52	53.71	63.81	63.10	50.27

Discussion of the Results.

The most important results obtained from the experiments reported in the previous pages are discussed under the following headings: —

Soy Bean Fodder (Brook's Medium Green). — This fodder was grown upon a twentieth-acre plat which had produced soy beans for two years previously. The crop was fertilized in the same way as that used in a digestion trial the previous year, and yielded at the rate of 6 tons to the acre. The fodder was cut from time to time as needed during the first fourteen days of September, the period proper lasting from the 8th to the 14th. The plants were fully podded and the beans quite well developed, but the foliage was still green. In common with other legumes at a similar stage of growth, the soy bean fodder showed a high protein percentage, and moderate percentages of fiber and extract matter.

Summary of Digestion Coefficients (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Young Sheep I., . . .	–	1	68.77	45.20	81.30	53.37	78.47	69.31
Young Sheep II., . . .	–	1	64.09	38.95	79.61	46.63	73.91	65.33
Young Sheep III., . . .	–	1	61.61	33.72	79.88	42.65	71.44	67.80
Average (1904), ...	1	3	64.82	39.29	80.26	47.55	74.61	67.50
Average (1903), ...	1	3	63.53	21.05	82.96	38.90	77.82	65.42
Average, both trials, . .	2	6	64.17	30.17	81.61	43.42	76.22	66.46
Average, all trials seeding, .	4	12	65.00	28.00	78.00	45.00	77.00	55.00
Clover for comparison, . .	3	7	66.00	–	70.00	54.00	72.00	64.00
Cowpea fodder for comparison,	2	4	68.00	23.00	76.00	60.00	81.00	59.00

The 1904 trial was made with one lot of sheep, and the 1903 trial with another. The results of both trials agree as closely as could be expected. The soy bean fodder appears to be slightly less digestible than that of other legumes, due in all probability to the tough, woody stems which are characteristic of the plant. Note the low digestibility of the fiber and the high digestibility of the protein.

Blomo Feed. — This feed, put out by the Blomo Manufacturing Company of New York, consisted of a fibrous material resembling ground corn stalks or cut hay, together with fresh blood and molasses. It was quite dark in color, coarse in appearance and rather sticky to the touch. Many samples contained an excess of moisture, which caused it to spoil during the warm season. The sample under examination contained, in dry matter, some 17 per cent. protein, 13 per cent. fiber and only a trace of fat.

Summary of Digestion Coefficients (Per Cent.).

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep II.,	1	1	64.02	31.20	64.48	50.81	73.20	13.79
Old Sheep III.,	1	1	69.46	31.62	60.98	71.89	78.70	16.75
Average,	1	2	66.74	31.41	62.73	61.35	75.95	15.27
Oats for comparison,	3	13	71.00	–	80.00	30.00	76.00	83.00
Rowen for comparison,	4	16	64.00	–	69.00	66.00	64.00	47.00

The parallel tests do not agree quite as closely as one could wish, the cause of the disagreement being due primarily to the fact that Sheep II. was not able to digest the fiber as fully as Sheep III. The percentage of fat is so small (less than 1 per cent.) that its digestibility is of minor consequence. It is understood that the Blomo feed was intended to be used chiefly as an oat substitute for horses. A comparison of the digestion coefficients of the two feeds proves the Blomo to be not quite as fully digested as the oats. The advantages, therefore, if any, of the Blomo feed would be due to the favorable effect of the molasses, and in its furnishing a change from the regular corn and oat diet. At the price asked Blomo could not be considered an economical feed for dairy stock. Its digestion coefficients do not vary greatly from those of a good quality of rowen, and it is doubtful if it would produce any more favorable results.

Malt Sprouts. — The sprouts were of good color, and contained nearly 29 per cent. of crude protein, 33.47 per cent. of which was in the amido form.

Summary of Digestion Coefficients (Per Cent.).

Period III.

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Young Sheep I., ...	1	1	89.03	33.30	77.23	100+	91.35	85.38
Young Sheep II., ...	1	1	75.13[1]	2.87	73.87	100.00	77.56	74.42
Young Sheep III., ...	1	1	81.45	21.18	76.67	98.26	86.99	100.00
Average, ...	1	3	81.87	19.12	75.92	99.42	85.30	86.60
Average, all trials, made in Massachusetts.	2	4	81.00	19.00	76.00	100.00	83.00	80.00
German trials,[2]	6	12	72.00[3]	-	80.00	55.00	73.00	71.00

The results with the three sheep show wide variations, especially in case of the total dry matter, ash and extract matter, and it is evident that difficulty was experienced in digesting the sprouts. Similar results were experienced in a previous trial,[4] two sheep digesting but 60 per cent. of the dry matter and a third 78 per cent. The results secured with the two former sheep were discarded. The high fiber coefficients in the present experiment indicate that the addition of the nitrogenous sprouts increased the digestibility of the hay fiber.

The results of German experiments likewise show especially wide variations in the digestibility of the organic matter, fiber and extract matter. The latter experiments do not show as high an average digestibility for fiber as do our own trials. It seems probable that these differences may be due largely to the character of the sprouts employed. Böhmer[5] states that light-colored sprouts show a higher degree of digestibility than dark-brown sprouts derived from slightly scorched malt. Kellner[6] has shown that, while the organic matter of the sprouts has a reasonably high digestibility because of the presence of considerable quantities of amids, cane sugar and organic acids, a definite amount does not have as great a feeding effect as does a like amount contained in the cereals.

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[1] The fæces from Sheep II. were somewhat soft for a few days during the collection, which was an evidence of indigestion.

[2] Kellner's Die Ernährung der Landw. Nutzthiere, page 570.

[3] Organic matter.

[4] See sixteenth report of this station, page 77.

[5] Kraftfuttermittel, page 206.

[6] *Loco citato*, pages 160, 357.

Sucrene Dairy Feed. — This is one of the so-called sugar feeds, consisting of wheat, corn, oats and barley products (or by-products), light oats, cotton-seed meal or other protein concentrate, and one-fourth to one-third molasses. The sample tested contained (in dry matter) 18.48 per cent. protein and 14.11 per cent. fiber.

Summary of Digestion Coefficients (*Per Cent.*).

Period IX.

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep II., ...	1	1	71.58	47.51	64.45	70.41	74.57	96.06
Old Sheep III., ...	1	1	67.38	27.92	57.12	73.46	70.50	92.75
Average, ...	1	2	69.48	37.72	60.79	71.94	72.54	94.41
Wheat bran for comparison, .	8	18	62.00	–	77.00	21.00	69.00	66.00
Flour middlings for comparison.	1	2	83.00	–	85.00	36.00	88.00	85.00
Gluten feed for comparison, .	5	11	85.00	–	85.00	76.00	89.00	83.00

The sugar feed may be said to be but moderately digestible. In total dry matter it is rather more digestible than bran, but the protein in the latter has noticeably higher digestion coefficients. It is decidedly less digestible than either flour middlings or gluten feed, and either of the two latter feeds would furnish digestible matter and especially digestible protein for less money than the Sucrene feed.

Holstein Sugar Feed. — This feed appeared to be a mixture of cereal products or by-products, molasses and some cotton-seed meal. It contained rather less water than the Sucrene, but was coarser and rather more sticky to handle.

Summary of Digestion Coefficients (Per Cent.).

Period X.

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Young Sheep I., ...	1	1	70.16	24.08	61.22	44.28	80.61	88.49
Young Sheep II., ...	1	1	74.13	31.74	64.90	62.30	82.04	88.61
Young Sheep III., ...	1	1	69.63	43.08	70.83	25.64	78.85	86.39
Average, ...	1	3	71.31	32.97	65.65	44.07	80.50	87.83

The dry matter of the Holstein feed was about as digestible as that contained in the Sucrene feed. Its fiber was rather less digestible and its extract matter had a higher digestibility than that contained in the latter feed.

Macon Sugar Feed. — This feed was furnished by Chapin & Co., and shipped from St. Louis. In appearance it quite closely resembled the Sucrene feed. The sample contained rather less protein and fiber and noticeably more extract matter than the Sucrene.

Summary of Digestion Coefficients (Per Cent.).

Period XI.

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep II., ...	1	1	69.03	20.52	60.50	36.40	80.83	74.07
Old Sheep III., ...	1	1	72.03	20.31	57.26	51.35	83.41	90.66
Average, ...	1	2	70.53	20.42	58.88	43.88	82.12	82.37

The results secured with the Macon feed do not vary materially from those obtained with the Sucrene and Holstein feeds. The fiber in the Macon is rather less and the extract matter more digestible than that contained in the Sucrene. In general it may be said that the digestibility of the three sugar feeds resembles each other quite closely.[1]

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[1] The economic value of these feeds will be more fully discussed in a future bulletin on the value of molasses and molasses feeds.

Eureka Silage Corn Stover. — This was derived from Eureka corn [1] grown on an experiment plat of the station during 1904, and cured in the stock out of doors. The corn was cut September 15, the ears at the time being only partially developed (kernels forming). The digestion experiment was made with the entire plant, minus the ears. In spite of the fact that the corn was well cured, it contained 62.89 per cent. water.

Pride of the North Corn Stover. — This corn was grown the same season, on a plat near by the Eureka, and received the same treatment. It was fairly well eared. The digestion test was made with the entire plant, minus the ears.

Summary of Digestion Coefficients (Per Cent.).

Periods V and VII.

		Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Eureka.	Old Sheep II.,	1	1	53.53	46.13	49.67	56.18	52.86	66.18
	Old Sheep III.,	1	1	55.27	43.88	46.91	61.94	52.99	66.98
	Average,	1	2	54.40	45.01	48.29	59.06	52.93	66.58
Pride of the North.	Old Sheep II.,	1	1	52.87	32.82	44.57	57.89	53.08	63.05
	Old Sheep III.,	1	1	55.06	29.36	45.12	62.60	54.68	65.75
	Average,	1	2	53.97	31.09	44.85	60.25	53.88	64.40
Average, all trials, for corn stover.		11	31	57.00	41.00	36.00	64.00	59.00	70.00

Both varieties of corn stover were equally well digested. The digestion coefficients are slightly lower than the average results of all trials.

English Hay. — This hay consisted largely of Kentucky blue grass (*Poa pratensis*), with an admixture of timothy, sweet vernal grass and red clover. It was cut June 20, when the blue grass and clover were in blossom, and carefully cured. The hay was used in connection with the several experiments reported in this series.

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[1] See eighteenth report of this station, pages 86–93.

Summary of Coefficients (Per Cent.).

Periods.		Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
VI.,	Paige Sheep IV., .	1	1	57.54	36.96	50.89	59.76	60.88	50.81
	Paige Sheep V., .	1	1	58.41	44.07	56.33	58.36	61.94	44.70
	Average, . .	1	2	57.98	40.52	53.61	59.06	61.44	47.76
IX.,	Old Sheep II., . .	1	1	61.72	47.36	55.54	64.52	64.01	50.45
	Old Sheep III., . .	1	1	59.74	43.67	51.87	63.09	62.18	50.08
	Average, . .	1	2	60.72	45.50	53.69	63.79	63.08	50.24
VIII.,	Young Sheep I., .	1	1	55.98	42.98	48.09	56.09	59.91	49.46
	Young Sheep II., .	1	1	59.03	43.77	47.36	61.21	62.65	52.80
	Young Sheep III., .	1	1	56.21	44.17	46.65	55.35	60.78	52.86
	Average, . .	1	3	57.07	43.64	47.37	57.55	61.11	51.71
	Average, all sheep, .	1	7	58.38	43.28	50.96	59.76	61.77	50.16
	Average, all previous trials.	15	60	60.00	47.00	57.00	60.00	61.00	50.00
	Average, timothy hay.	24	58	55.00	39.00	48.00	50.00	62.00	50.00

The so-called "Old Sheep" gave slightly higher coefficients than the other two lots. The former are some six years and the latter four years old. This difference in ability to digest, especially between the old and young sheep, has been noticed repeatedly. The hay gave about the same digestion coefficients as those secured with similar lots in previous trials. Hay of this character, designated "cow hay" by farmers, tests higher in protein, is rather more digestible, and probably requires less energy for its digestion than timothy hay.

Hominy Feed. — This material consisted of the hull, germ and some of the gluten and starch of the Indian corn. The sample appeared to be of good average quality.

Summary of Digestion Coefficients (Per Cent.).

Period XII.

	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	89.26	37.38	67.23	97.43	94.42	88.62
Paige Sheep V., ...	1	1	85.90	60.37	71.85	62.49	90.79	87.70
Average, ...	1	2	87.58	48.88	69.54	79.96	92.61	88.16
Average, 1903,[1]	1	3	80.75	22.74	67.48	–	85.97	91.61
Average, 1904,[1]	1	3	79.42	38.26	58.07	38.12	87.66	94.09
Average, all trials, . . .	3	8	81.96	35.10	64.47	79.96	88.26	91.68
Corn meal for comparison, .	–	–	89.00	–	76.00	–	94.00	91.00

[1] Seventeenth report of this station, page 75.

The results of the two trials in the present experiment agree fairly well one with the other, and the average of the two are nearly equal to the coefficients for corn meal. The coefficients secured with the several sheep in the two previous experiments (1903 and 1904) showed marked differences. While these variations may have been due partially to the quality of the two different lots of hominy (which, however, could not be detected by chemical analysis), it seems probable that the chief cause for the lack of agreement is to be found in the sheep themselves. The writer has frequently noticed that after sheep have been used in digestion work for a number of months their power to digest becomes temporarily weakened. This condition is more noticeable with some sheep than with others, and evidently depends largely upon individuality. The digestion coefficients for hominy secured with the Old Sheep (1903) were obtained in one of a series of experiments extending from the autumn of 1902 to March 1903. The hominy meal period was the last of the series, and the digestibility of the dry matter varied from 71 to 91 per cent. The coefficients reported with the Young Sheep (1904) (75 to 86 per cent. of dry matter digestible) were obtained in a series extending from the autumn of 1903 to the spring of 1904. These sheep were used for the first time in this series, and were alternated to an extent with the Old

Sheep. The hominy feed was used in the last of four experiments made with these sheep during the series. While the latter results agree better than those secured with the Old Sheep, they were not as satisfactory as could be desired.

The average of all trials show the dry matter to be 82 per cent. digestible. It is believed, however, that the coefficients secured with the Paige Sheep (fully reported in the present trial) more closely represent the digestibility of the best grades of hominy feed. Allowing hominy feed to contain 91 per cent. and corn meal 86 per cent. of dry matter, and applying the average digestion coefficients secured for hominy and corn meal, the former would contain 1,492 pounds and the latter 1,541 pounds digestible dry matter in one ton. By using the coefficients secured with the Paige Sheep, the hominy is shown to contain 1,565 pounds of digestible dry matter in a ton. It may therefore safely be assumed that a ton of standard hominy feed has fully as much digestible matter as is contained in a like quantity of an average quality of corn meal. Hominy contains rather more protein and noticeably more fat than clear corn, and for some purposes may be considered a preferable feed.

Oat Middlings, occasionally found upon the market, is presumably the fine residue from the oatmeal factories. It contains but a few per cent. of fiber, about 9 per cent. of water, 16 per cent. of protein and 6 per cent. of fat.

Summary of Digestion Coefficients (Per Cent.).

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep I., ...	1	1	91.27	31.28	81.18	76.54	96.58	92.81
Paige Sheep II., . . .	1	1	88.02	39.83	79.53	21.32	93.95	93.63
Average, ...	1	2	89.65	35.56	80.36	48.93	95.27	93.22
Average fine wheat middlings for comparison.	2	4	82.00	–	88.00	36.00	88.00	86.00

The oat middlings are shown to be quite thoroughly digested, especially the starchy matter and fat; the protein had also a relatively high digestibility. The small amount of fiber present renders its degree of digestibility comparatively unimportant. Judged from composition and digestibility, this oat by-product would be a few per cent. more valuable than average wheat flour middlings for ordinary feeding purposes. It ought to make a valuable feed for young calves.

Buckwheat Middlings. — This material is the residue from small mills which prepare buckwheat flour for human use. It consisted of the middlings and a small portion of the bran. Genuine buckwheat middlings should contain 25 per cent. of protein, 7 per cent. of fat and not over 10 per cent. of fiber. Samples found in the market known as buckwheat feed frequently show a considerable admixture of the bran and analyze as high as 25 per cent. of fiber. Buckwheat bran is very indigestible, and consequently such material is quite inferior in feeding value to the straight middlings.

Summary of Digestion Coefficients (Per Cent.).

Period XIII.

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Young Sheep I.,	1	1	75.14	25.80	86.04	7.74	83.56	88.31
Young Sheep II.,	1	1	78.72	41.35	83.03	26.11	87.00	92.30
Young Sheep III.,	1	1	71.27	39.52	86.31	–	79.24	87.47
Average,	1	3	75.04	35.56	85.13	16.92[1]	83.27	89.36
Gluten feed for comparison,	7	13	86.00	–	85.00	76.00	89.00	83.00

Sheep III. did not digest the middlings quite as well as the other two sheep. The material, as is shown by the coefficients obtained for the dry matter, appeared to be fairly well digested, although not as fully as the easily digested gluten feed. The protein had a high digestibility, being equal to other high-grade protein concentrates. It is evident from the analysis, from the digestion coefficients obtained and from the retail price of the article ($26 to $28 a ton) that genuine buckwheat middlings is an economical source of dry matter and digestible protein.[1]

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[1] Average, two trials.

[2] It is not advisable to feed over 3 pounds of this material daily to mature dairy stock; larger quantities are likely to cause illness.

Series XI.

This series was begun August 12, 1905, with Early Amber Sorghum, and continued until April 7, 1906. The Paige Sheep worked especially well in this series, and were used in the larger number of the experiments. The digestion hay used in periods III. and IV. was the new hay described in the previous series, to which the reader is referred for composition and digestion coefficients. The composition of the hay used in all other periods is given in the table of analyses. The coefficients employed were the following: —

	Old Sheep II. and III.	Young Sheep I., II. and III.	Paige Sheep IV. and V.
Dry matter,	67.87	65.92	65.48
Ash,	49.17	51.95	44.60
Protein,	62.31	61.98	61.53
Fiber,	76.30	72.87	73.81
Nitrogen-free extract,	66.39	64.66	64.46
Fat,	52.37	54.23	50.20

Composition of Feed Stuffs (Per Cent.).

[Dry Matter.]

Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
English hay (used in 1904–05 experiments),	8.20	8.69	32.14	48.56	2.41
Early Amber Sorghum fodder,	6.06	6.24	29.28	56.00	2.42
Pride of the North corn fodder,	5.56	8.83	23.11	60.24	2.26
Porto Rico molasses,	8.45	3.94	–	87.61	–
English hay (new lot, 1905–06),	6.75	12.23	33.45	44.67	2.90
Gluten feed,	1.67	24.98	7.22	63.34	2.79
Porto Rico molasses,	9.22	3.94	–	86.84	–
Green Diamond sugar feed,	9.88	13.71	15.27	58.47	2.67
Sea Island cotton-seed meal,	5.20	27.31	19.67	41.47	6.35
Red wheat meal,	1.92	9.96	2.99	82.83	2.80
Leaming corn silage,	6.07	10.19	26.06	54.89	2.79
White winter wheat meal,	1.90	13.07	2.38	80.49	2.16
Feed barley (ground),	3.27	14.60	6.19	73.90	2.04

Composition of Fæces (Per Cent.).

[Dry Matter.]

Young Sheep I.

Periods.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
IX.,	English hay (1905–06),	9.82	13.27	26.90	46.01	4.00
XII.,	Red wheat meal,	9.91	15.66	24.82	45.61	4.00
XV.,	White winter wheat,	10.39	14.70	24.51	46.02	4.38
	Young Sheep II.					
IX.,	English hay (1905–06),	9.68	14.55	25.28	46.62	3.87
XV.,	White winter wheat,	11.60	15.20	24.26	45.16	3.78
	Young Sheep III.					
IX.,	English hay (1905–06),	9.07	13.14	27.65	46.32	3.82
XII.,	Red wheat meal,	9.24	15.08	25.85	46.02	3.81
XV.,	White winter wheat,	9.15	14.24	26.30	46.23	4.08
	Old Sheep II.					
II.,	Pride of the North corn fodder,	11.86	11.17	27.55	47.68	1.74
VI.,	English hay (1905–06),	10.80	14.70	23.99	46.27	4.24
XIII.,	Leaming corn silage,	10.48	13.70	25.15	47.75	2.92
	Old Sheep III.					
II.,	Pride of the North corn fodder,	12.86	11.18	27.68	46.35	1.93
VI.,	English hay (1905–06),	10.57	14.03	25.31	45.74	4.35
X.,	Green Diamond sugar feed,	14.70	13.68	24.47	44.42	2.73
XIII.,	Leaming corn silage,	10.39	13.02	25.14	48.47	2.98
	Paige Sheep IV.					
I.,	Early Amber Sorghum,	11.28	11.13	27.02	47.44	3.13
III.,	Porto Rico molasses,	12.16	10.72	29.32	44.87	2.93
IV.,	Porto Rico molasses,	13.66	11.47	27.13	44.86	2.88
V.,	English hay (1905–06),	11.18	14.10	24.20	46.24	4.28
VII.,	Gluten feed,	10.55	15.33	22.35	47.20	4.57
VIII.,	Gluten feed and molasses,	11.15	16.36	21.26	47.44	3.79
XI.,	Sea Island cotton-seed meal,	8.67	14.17	32.75	41.31	3.10
XIV.,	Green Diamond sugar feed,	13.02	12.79	25.41	45.59	3.19
XVI.,	Feed barley,	12.50	13.86	23.08	46.46	4.10

Composition of Fæces — Concluded.

[Dry Matter.]

Paige Sheep V.

Periods.	Feeds.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
I.,	Early Amber Sorghum, . . .	11.06	9.39	31.21	45.75	2.59
III.,	Porto Rico molasses, ...	11.83	10.53	30.33	44.47	2.84
IV.,	Porto Rico molasses, ...	12.87	11.49	28.95	43.94	2.75
V.,	English hay (1905–06), . . .	10.49	13.17	26.51	45.74	4.09
VII.,	Gluten feed, ...	10.63	15.05	22.84	46.84	4.64
VIII.,	Gluten feed and molasses, . . .	10.82	16.21	22.09	47.15	3.73
XI.,	Sea Island cotton-seed meal, . .	9.33	15.20	29.46	42.86	3.15
XVI.,	Feed barley, ...	11.14	13.86	25.39	45.75	3.86

Dry Matter Determinations made at the Time of weighing out the Different Foods, and Dry Matter in Air-dry Fæces (Per Cent.).

Paige Sheep IV.

Periods.	English Hay.	Early Amber Sorghum.	Porto Rico Molasses.	Gluten Feed.	Sea Island Cotton-seed Meal.	Green Diamond Sugar Feed.	Feed Barley.	Fæces.
I.,	–	16.35	–	–	–	–	–	87.84
III.,	88.15	–	71.49	–	–	–	–	92.84
IV.,	87.22	–	72.12	–	–	–	–	92.33
V.,	88.65	–	–	–	–	–	–	92.22
VII.,	88.55	–	–	90.03	–	–	–	93.47
VIII.,	88.92	–	72.67	92.02	–	–	–	92.50
XI.,	90.92	–	–	–	90.97	–	–	93.16
XIV.,	90.17	–	–	–	–	89.62	–	94.42
XVI.,	89.35	–	–	–	–	–	89.07	92.96

Paige Sheep V.

I.,	–	16.35	–	–	–	–	–	87.69
III.,	88.15	–	71.49	–	–	–	–	93.14
IV.,	87.22	–	72.12	–	–	–	–	92.16
V.,	88.65	–	–	–	–	–	–	92.14
VII.,	88.55	–	–	90.03	–	–	–	93.61
VIII.,	88.92	–	72.67	92.02	–	–	–	92.36
XI.,	90.92	–	–	–	90.97	–	–	92.98
XVI.,	89.35	–	–	–	–	–	89.07	92.80

Dry Matter Determinations, etc. — Concluded..

Young Sheep I.

PERIODS.	English Hay.	Pride of the North Corn Fodder.	Green Diamond Sugar Feed.	Red Wheat Meal.	Leaming Corn Silage.	White Wheat Meal.	Fæces.
IX.,	90.35	–	–	–	–	–	94.99
XII.,	88.92	–	–	87.43	–	–	94.25
XV.,	89.60	–	–	–	–	87.80	93.27

Young Sheep II.

IX.,	90.35	–	–	–	–	–	94.72
XV.,	89.60	–	–	–	–	87.80	92.91

Young Sheep III.

IX.,	90.35	–	–	–	–	–	94.86
XII.,	88.92	–	–	87.43	–	–	94.17
XV.,	89.60	–	–	–	–	87.80	93.09

Old Sheep II.

II.,	–	22.61	–	–	–	–	89.28
VI.,	88.97	–	–	–	–	–	93.54
XIII.,	90.17	–	–	–	21.44	–	94.12

Old Sheep III.

II.,	–	22.61	–	–	–	–	89.09
VI.,	88.97	–	–	–	–	–	93.52
X.,	88.95	–	91.95	–	–	–	94.09
XIII.,	90.17	–	–	–	21.44	–	94.19

Average Daily Amount of Manure excreted and Water drank (*Grams*).

Paige Sheep IV.

Periods.	CHARACTER OF FOOD OR RATION.	Manure excreted daily.	One-tenth Manure Air Dry.	Water drank daily.
I.,	Early Amber Sorghum,	500	41.06[1]	49
III.,	Hay and Porto Rico molasses,	674	31.10	1,725
IV.,	Hay and Porto Rico molasses,	738	33.34	2,114
V.,	English hay,	610	26.11	1,781
VII.,	Hay and gluten feed,	460	20.82	1,498
VIII.,	Hay, gluten feed and molasses,	635	25.84	1,843
XI.,	Hay and Sea Island cotton-seed meal,	607	29.67	2,095
XIV.,	Hay and Green Diamond sugar feed,	598	27.45	2,241
XVI.,	Hay and feed barley,	478	20.32	1,644

[1] One-fifth of daily amount excreted.

Average Daily Amount of Manure excreted and Water drank (Grams) — Concluded.

Paige Sheep V.

Periods.	Character of Food or Ration.	Manure excreted daily.	One-tenth Manure Air Dry.	Water drank daily.
I.,	Early Amber Sorghum,	591	43.80[1]	55
III.,	Hay and Porto Rico molasses,	745	32.86	1,995
IV.,	Hay and Porto Rico molasses,	855	34.12	2,014
V.,	English hay,	623	27.02	1,642
VII.,	Hay and gluten feed,	459	20.01	1,318
VIII.,	Hay, gluten feed and molasses,	655	25.86	1,953
XI.,	Hay and Sea Island cotton-seed meal,	673	26.70	2,138
XIV.,	Hay and Green Diamond sugar feed,	–	–	–
XVI.,	Hay and feed barley,	705	21.50	1,644

[1] One-fifth of daily amount excreted.

Young Sheep I.

IX.,	English hay (new lot),	635	27.46	2,170
XII.,	Hay and red wheat meal,	557	20.98	2,025
XV.,	Hay and white winter wheat,	488	21.86	2,038

Young Sheep II.

IX.,	English hay (new lot),	779	26.96	2,341
XII.,	Hay and red wheat meal,	–	–	–
XV.,	Hay and white winter wheat,	1,077	24.15	2,338

Young Sheep III.

IX.,	English hay (new lot),	695	28.35	2,495
XII.,	Hay and red wheat meal,	617	22.32	2,352
XV.,	Hay and white winter wheat,	537	22.99	2,495

Old Sheep II.

II.,	Pride of the North corn fodder,	624	25.62	80
VI.,	English hay (1905–06),	613	26.21	1,694
X.,	Hay and Green Diamond sugar feed,	–	–	–
XIII.,	Hay and Leaming corn silage,	747	24.04	1,974

Old Sheep III.

II.,	Pride of the North corn fodder,	820	28.12	60
VI.,	English hay (1905–06),	608	28.80	1,544
X.,	Hay and Green Diamond sugar feed,	676	27.08	2,329
XIII.,	Hay and Leaming corn silage,	537	22.42	1,309

Weights of Animals at Beginning and End of Period (Pounds).

Paige Sheep IV.

Periods.	CHARACTER OF FOOD OR RATION.	Beginning.	End.
I.,	Early Amber Sorghum,	147.00	146.50
III.,	Hay and Porto Rico molasses,	144.00	142.00
IV.,	Hay and Porto Rico molasses,	145.50	150.00
V.,	English hay,	142.00	144.00
VII.,	Hay and gluten feed,	141.50	141.00
VIII.,	Hay, gluten feed and molasses,	145.00	142.00
XI.,	Hay and Sea Island cotton-seed meal,	144.00	145.00
XIV.,	Hay and Green Diamond sugar feed,	145.50	148.50
XVI.,	Hay and feed barley,	148.00	143.50

Paige Sheep V.

Periods.	CHARACTER OF FOOD OR RATION.	Beginning.	End.
I.,	Early Amber Sorghum,	124.25	126.00
III.,	Hay and Porto Rico molasses,	124.00	122.00
IV.,	Hay and Porto Rico molasses,	122.50	125.50
V.,	English hay,	122.00	121.50
VII.,	Hay and gluten feed,	118.50	120.00
VIII.,	Hay, gluten feed and molasses,	125.50	122.50
XI.,	Hay and Sea Island cotton-seed meal,	124.50	123.50
XIV.,	Hay and Green Diamond sugar feed,	–	–
XVI.,	Hay and feed barley,	124.50	117.00

Young Sheep I.

Periods.	CHARACTER OF FOOD OR RATION.	Beginning.	End.
IX.,	English hay (1905–06),	121.00	119.00
XII.,	Hay and red wheat meal,	118.00	117.00
XV.,	Hay and white winter wheat,	119.50	118.00

Young Sheep II.

Periods.	CHARACTER OF FOOD OR RATION.	Beginning.	End.
IX.,	English hay (1905–06),	111.00	113.00
XII.,	Hay and red wheat meal,	–	–
XV.,	Hay and white winter wheat,	–	–

Young Sheep III.

Periods.	CHARACTER OF FOOD OR RATION.	Beginning.	End.
IX.,	English hay (1905–06),	113.00	110.00
XII.,	Hay and red wheat meal,	109.00	109.00
XV.,	Hay and white winter wheat,	110.00	108.50

Weights of Animals at Beginning and End of Period (Pounds) — Concluded.

Old Sheep II.

Periods.	Character of Food or Ration.	Beginning.	End.
II.,	Pride of the North corn fodder, ...	160.00	154.00
VI.,	English hay (1905–06), ...	154.00	150.00
X.,	Hay and Green Diamond sugar feed, . . .	–	–
XIII.,	Hay and Leaming corn silage, ...	154.50	155.00

Old Sheep III.

II.,	Pride of the North corn fodder, ...	151.50	150.00
VI.,	English hay (1905–06), ...	146.50	145.00
X.,	Hay and Green Diamond sugar feed, . . .	145.00	147.50
XIII.,	Hay and Leaming corn silage, ...	152.00	152.00

Early Amber Sorghum. — Period I.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,600 grams Sorghum fodder fed, .	588.60	35.67	36.73	172.34	329.62	14.24
205.30 grams manure excreted, . .	180.34	20.34	20.07	48.73	85.55	5.64
Grams digested, ...	408.26	15.33	16.66	123.61	244.07	8.60
Per cent. digested, ...	69.36	42.98	45.36	71.72	74.04	60.39

Paige Sheep V.

3,600 grams Sorghum fodder fed, .	588.60	35.67	36.73	172.34	329.62	14.24
219 grams manure excreted, . . .	192.04	21.24	18.03	59.94	87.86	4.97
Grams digested, ...	396.56	14.43	18.70	112.40	241.76	9.27
Per cent. digested, ...	67.37	40.45	50.91	65.22	73.35	65.10
Average per cent. for both sheep, .	68.37	41.72	48.14	68.47	73.70	62.75

Average nutritive ratio of rations for two sheep, 1:21.5.

Pride of the North Corn Fodder. — Period II.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,600 grams Pride of the North corn fodder fed.	813.96	45.26	71.87	188.11	490.33	18.40
256.23 grams manure excreted, . .	228.76	27.13	25.55	63.02	109.07	3.98
Grams digested, ...	585.20	18.13	46.32	125.09	381.26	14.42
Per cent. digested, ...	71.89	40.06	64.45	66.50	77.76	78.37

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3,600 grams Pride of the North corn fodder fed.	813.96	45.26	71.87	188.11	490.33	18.40
281.19 grams manure excreted, . .	250.51	32.22	28.01	69.34	116.11	4.83
Grams digested, ...	563.45	13.04	43.86	118.77	374.22	13.57
Per cent. digested, ...	69.22	28.81	61.03	63.14	76.32	73.75
Average per cent. for both sheep, .	70.56	34.43	62.74	64.82	77.04	76.06

Average nutritive ratio of rations for two sheep, 1:11.8.

Porto Rico Molasses. — Period III.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed, . . .	705.20	57.83	61.28	226.65	342.45	17.00
150 grams molasses fed, ...	107.24	9.06	4.23	–	93.95	–
Amount consumed, ...	812.44	66.89	65.51	226.65	436.40	17.00
311 grams manure excreted, . . .	288.73	35.11	30.95	84.66	129.55	8.46
Grams digested, ...	523.71	31.78	34.56	141.89	306.85	8.54
Minus hay digested, ...	408.87	23.43	32.85	133.86	210.30	8.12
Molasses digested, ...	114.84	8.35	1.71	8.03	96.55	.42
Per cent. digested, ...	107.09	92.16	40.43	–	102.76	–

Paige Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above, . .	812.44	66.89	65.51	226.65	436.40	17.00
328.60 grams manure excreted, . .	306.06	36.21	32.23	92.83	136.10	8.69
Grams digested, ...	506.38	30.68	33.28	133.82	300.30	8.31
Minus hay digested, ...	408.87	23.43	32.85	133.86	210.30	8.12
Molasses digested, ...	97.51	7.25	.43	–	90.00	.19
Per cent. digested, ...	90.93	80.02	10.17	–	95.80	–
Average per cent. for both sheep, .	99.01	86.09	25.30	–	99.28	–

Average nutritive ratio of rations for two sheep, 1:13.6.

Porto Rico Molasses. — *Period IV.*

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	697.76	57.22	60.64	224.26	338.82	16.82
250 grams molasses fed,	180.30	15.24	7.10	–	157.96	–
Amount consumed,	878.06	72.46	67.74	224.26	496.78	16.82
333.40 grams manure excreted,	307.83	42.05	35.31	83.51	138.09	8.87
Grams digested,	570.23	30.41	32.43	140.75	358.69	7.95
Minus hay digested,	404.56	23.19	32.51	132.44	208.07	8.03
Molasses digested,	165.67	7.22	—.08	8.31	150.62	–
Per cent. digested,	91.89	47.38	–	–	95.35	–

Paige Sheep V.

Amount consumed as above,	878.06	72.46	67.74	224.26	496.78	16.82
341.2 grams manure excreted,	314.45	40.47	36.13	91.03	138.17	8.65
Grams digested,	563.61	31.99	31.61	133.23	358.61	8.17
Minus hay digested,	404.56	23.19	32.51	132.44	208.07	8.03
Molasses digested,	159.05	8.80	.10	.79	150.54	.14
Per cent. digested,	88.21	57.74	–	–	95.30	–
Average per cent. for both sheep,	90.05	52.56	–	–	95.33	–

Average nutritive ratio of rations for two sheep, 1: 16.

English Hay. — *Period V.*

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
800 grams English hay fed,	709.20	47.87	86.74	237.23	316.80	20.57
261.10 grams manure excreted,	240.79	26.92	33.95	58.27	111.34	10.31
Grams digested,	468.41	20.95	52.79	178.96	205.46	10.26
Per cent. digested,	66.05	43.76	60.86	75.44	64.85	49.88

Paige Sheep V.

800 grams English hay fed,	709.20	47.87	86.74	237.23	316.80	20.57
270.20 grams manure excreted,	248.96	26.12	32.79	66.00	113.87	10.18
Grams digested,	460.24	21.75	53.95	171.23	202.93	10.39
Per cent. digested,	64.90	45.44	62.20	72.18	64.06	50.51
Average per cent. for both sheep,	65.48	44.60	61.53	73.81	64.46	50.20

Average nutritive ratio of rations for two sheep, 1: 7.5.

English Hay. — Period VI.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams English hay fed, . . .	800.73	54.05	97.93	267.84	357.69	23.22
262.10 grams manure excreted, . .	245.17	26.48	36.04	58.82	113.44	10.40
Grams digested, ...	555.56	27.57	61.89	209.02	244.25	12.82
Per cent. digested, ...	69.38	51.01	63.20	78.04	68.29	55.21
Old Sheep III.						
900 grams English hay fed, . . .	800.73	54.05	97.93	267.84	357.69	23.22
288 grams manure excreted, . . .	269.34	28.47	37.79	68.17	123.20	11.72
Grams digested, ...	531.39	25.58	60.14	199.67	234.49	11.50
Per cent. digested, ...	66.36	47.33	61.41	74.55	65.56	49.53
Average per cent. for both sheep, .	67.87	49.17	62.31	76.30	66.39	52.37

Average nutritive ratio of rations for two sheep, 1: 7.7.

Gluten Feed. — Period VII.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed, . . .	531.30	35.86	64.98	177.72	237.33	15.41
200 grams gluten feed fed, . . .	180.06	3.01	44.98	13.00	114.05	5.02
Amount consumed, ...	711.36	38.87	109.96	190.72	351.38	20.43
208.20 grams manure excreted, . .	194.60	20.53	29.83	43.49	91.85	8.89
Grams digested, ...	516.76	18.34	80.13	147.23	259.53	11.54
Minus hay digested, ...	347.90	15.99	39.98	131.18	152.98	7.74
Gluten feed digested, ...	168.86	2.35	40.15	16.05	106.55	3.80
Per cent. digested, ...	93.78	78.07	89.26	123.46	93.42	75.70
Paige Sheep V.						
Amount consumed as above, . .	711.36	38.87	109.96	190.72	351.38	20.43
200.10 grams manure excreted, . .	187.31	19.91	28.19	42.78	87.74	8.69
Grams digested, ...	524.05	18.96	81.77	147.94	263.64	11.74
Minus hay digested, ...	347.90	15.99	39.98	131.18	152.98	7.74
Gluten feed digested, ...	176.15	2.97	41.79	16.76	110.66	4.00
Per cent. digested, ...	97.83	98.67	92.91	128.92	97.03	79.68
Average per cent. for both sheep, .	95.81	88.37	91.09	126.19	95.23	77.69

Average nutritive ratio of rations for two sheep, 1: 5.4.

Porto Rico Molasses. — Period VIII.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed, . . .	533.52	36.01	65.25	178.46	238.32	15.47
200 grams gluten feed fed, . . .	184.04	3.07	45.97	13.29	116.57	5.13
250 grams molasses fed, ...	181.68	16.75	7.16	–	157.77	–
Amount consumed, ...	899.24	55.83	118.38	191.75	512.66	20.60
258.40 grams manure excreted, . .	239.02	26.65	39.10	50.82	113.39	9.06
Grams digested, ...	660.22	29.18	79.28	140.93	399.27	11.54
Minus hay and gluten feed digested, .	521.24	18.44	81.05	–	262.12	–
Molasses digested, ...	138.98	10.74	–	–	137.15	–
Per cent. digested, ...	76.50	64.12	–	–	86.93	–

Paige Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above, . .	899.24	55.83	118.38	191.75	512.66	20.60
258.60 grams manure excreted, . .	238.84	25.84	38.72	52.76	112.61	8.91
Grams digested, ...	660.40	29.99	79.66	138.99	400.05	11.69
Minus hay and gluten feed digested, .	528.63	19.06	82.70	–	266.27	–
Molasses digested, ...	131.77	10.93	–	–	133.78	–
Per cent. digested, ...	72.53	65.25	–	–	84.80	–
Average per cent. for both sheep, .	74.52	64.69	–	–	85.87	–

Average nutritive ratio of rations for two sheep, 1: 7.1.

English Hay. — Period IX.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay fed, . . .	767.98	51.84	93.92	256.89	342.96	22.27
274.60 grams manure excreted, . .	260.84	25.61	34.61	70.17	120.01	10.43
Grams digested, ...	507.14	26.23	59.31	186.72	222.95	11.84
Per cent. digested, ...	66.04	50.60	63.15	72.68	65.01	53.17

Young Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay fed, . . .	767.98	51.84	93.92	256.89	342.96	22.27
269.60 grams manure excreted, . .	255.37	24.72	37.16	64.56	119.05	9.88
Grams digested, ...	512.61	27.12	56.76	192.33	223.91	12.39
Per cent. digested, ...	66.75	52.31	60.43	74.87	65.29	55.64

English Hay — Concluded.

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
850 grams English hay fed, . . .	767.98	51.84	93.92	256.89	342.96	22.27
283.50 grams manure excreted, . .	268.93	24.39	35.34	74.36	124.57	10.27
Grams digested, ...	499.05	27.45	58.58	182.53	218.39	12.00
Per cent. digested, ...	64.98	52.95	62.37	71.05	63.68	53.88
Average per cent. for three sheep, .	65.92	51.95	61.98	72.87	64.66	54.23

Average nutritive ratio of rations for three sheep, 1:7.5.

Green Diamond Sugar Feed. — Periods X. and XIV.

Old Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
400 grams Green Diamond sugar feed fed.	367.80	36.34	50.43	56.16	215.05	9.82
500 grams English hay fed, . . .	444.75	30.02	54.39	148.77	198.67	12.90
Amount consumed, ...	812.55	66.36	104.82	204.93	413.72	22.72
270.80 grams manure excreted, . .	254.80	37.46	34.86	62.35	113.18	6.96
Grams digested, ...	557.75	28.90	69.96	142.58	300.54	15.76
Minus hay digested, ...	301.85	14.76	33.89	113.51	131.90	6.76
Sugar feed digested, ...	255.90	14.14	36.07	29.07	168.64	9.00
Per cent. digested, ...	69.58	38.91	71.52	51.76	78.42	91.65

Paige Sheep IV.

300 grams Green Diamond sugar feed,	268.86	26.56	36.86	41.05	157.20	7.18
500 grams English hay fed, . . .	450.85	30.43	55.14	150.81	201.39	13.07
Amount consumed, ...	719.71	56.99	92.00	191.86	358.59	20.25
274.5 grams manure excreted, . .	259.18	33.75	33.15	65.86	118.16	8.27
Grams digested, ...	460.53	23.24	58.85	126.00	240.43	11.98
Minus hay digested, ...	295.21	13.57	33.93	111.31	129.82	6.56
Sugar feed digested, ...	165.32	9.67	24.92	14.69	110.61	5.42
Per cent. digested, ...	61.49	36.41	67.61	35.79	70.36	75.49
Average per cent. for both sheep, .	65.54	37.66	69.57	43.78	74.39	83.57

Average nutritive ratio of rations for two sheep, 1:6.8.

Sea Island Cotton-seed Meal. — Period XI.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
200 grams Sea Island cotton-seed meal fed.	181.94	9.46	49.69	35.79	75.45	11.55
650 grams English hay fed, . . .	590.98	39.89	72.28	197.68	263.99	17.14
Amount consumed, ...	772.92	49.35	121.97	233.47	339.44	28.69
296.70 grams manure excreted, . .	276.41	23.96	39.17	90.52	114.18	8.57
Grams digested, ...	496.51	25.39	82.80	142.95	225.26	20.12
Minus hay digested, ...	386.97	17.79	44.47	145.91	170.17	8.60
Cotton-seed meal digested, . . .	109.54	7.60	38.33	–	55.09	11.52
Per cent. digested, ...	60.21	80.34	77.14	–	73.02	99.74

Paige Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above, . .	772.92	49.35	121.97	233.47	339.44	28.69
267 grams manure excreted, . . .	248.23	23.16	37.73	73.13	106.39	7.82
Grams digested, ...	524.69	26.19	84.24	160.34	233.05	20.87
Minus hay digested, ...	386.97	17.79	44.47	145.91	170.17	8.60
Cotton-seed meal digested, . . .	137.72	8.40	39.77	14.43	62.88	12.27
Per cent. digested, ...	75.69	88.79	80.04	40.32	83.34	100+
Average per cent. for both sheep, .	67.95	84.56	78.39	40.32	78.18	100

Average nutritive ratio of rations for two sheep, 1:5.1.

Red Wheat Meal. — Period XII.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed, . . .	489.06	33.01	59.81	163.59	218.46	14.18
300 grams red wheat meal fed, . .	262.29	5.04	26.12	7.84	215.94	7.34
Amount consumed, ...	751.35	38.05	85.93	171.43	434.40	21.52
209.80 grams manure excreted, . .	197.74	19.60	30.97	49.08	90.19	7.91
Grams digested, ...	553.61	18.45	54.96	122.35	344.21	13.61
Minus hay digested, ...	322.39	17.15	37.07	119.21	141.26	7.69
Red wheat meal digested, . . .	231.22	1.30	17.89	3.14	202.95	5.92
Per cent. digested, ...	88.15	25.79	68.49	40.05	93.98	80.65

Red Wheat Meal — Concluded.

Young Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	751.35	38.05	85.93	171.43	434.40	21.52
223.20 grams manure excreted,	210.19	19.42	31.70	54.33	96.73	8.01
Grams digested,	541.16	18.63	54.23	117.10	337.67	13.51
Minus hay digested,	322.39	17.15	37.07	119.21	141.26	7.69
Red wheat meal digested,	218.77	1.48	17.16	–	196.41	5.82
Per cent. digested,	83.41	29.37	65.70	–	90.96	79.29
Average per cent. for both sheep,	85.78	27.58	67.10	–	92.47	79.97

Average nutritive ratio of rations for two sheep, 1: 9.

Leaming Corn Silage. — Period XIII.

Old Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
400 grams English hay fed,	360.68	24.35	44.11	120.65	161.12	10.46
1,600 grams corn silage fed,	343.04	20.82	34.96	89.40	188.29	9.57
Amount consumed,	703.72	45.17	79.07	210.05	394.41	20.03
240.40 grams manure excreted,	226.26	23.71	31.00	56.90	108.04	6.61
Grams digested,	477.46	21.46	48.07	153.15	241.37	13.42
Minus hay digested,	244.79	11.97	27.48	92.06	106.97	5.48
Corn silage digested,	232.67	9.49	20.59	61.09	134.40	7.94
Per cent. digested,	67.82	45.58	58.89	68.33	71.38	82.97

Old Sheep III.

Amount consumed as above,	703.72	45.17	79.07	210.05	349.41	20.03
224.20 grams manure excreted,	211.17	21.94	27.49	53.09	102.35	6.29
Grams digested,	492.55	23.23	51.58	157.96	247.06	13.74
Minus hay digested,	244.79	11.97	27.48	92.06	106.97	5.48
Corn silage digested,	247.76	11.26	24.10	65.90	140.09	8.26
Per cent. digested,	72.22	54.08	68.93	73.71	74.40	86.31
Average per cent. for both sheep,	70.02	49.83	63.91	71.02	72.89	84.64

Average nutritive ratio of rations for two sheep, 1: 8.6.

White Winter Wheat Meal. — Period XV.

Young Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams English hay fed,	537.60	36.29	65.75	179.83	240.15	15.59
250 grams wheat meal fed,	219.50	4.17	28.69	5.22	176.68	4.74
Amount consumed,	757.10	40.46	94.44	185.05	416.83	20.33
218.60 grams manure excreted,	203.89	21.18	29.97	49.97	93.83	8.93
Grams digested,	553.21	19.28	64.47	135.08	323.00	11.40
Minus hay digested,	354.39	18.85	40.75	131.04	155.28	8.45
Wheat meal digested,	198.82	.43	23.72	4.04	167.72	2.95
Per cent. digested,	90.58	10.31	82.68	77.39	94.93	62.24

Young Sheep III.

Amount consumed as above,	757.10	40.46	94.44	185.05	416.83	20.33
229.90 grams manure excreted,	214.01	19.58	30.48	56.28	98.94	8.73
Grams digested,	543.09	20.88	63.96	128.77	317.89	11.60
Minus hay digested,	354.39	18.85	40.75	131.04	155.28	8.45
Wheat meal digested,	188.70	2.03	23.21	–	162.61	3.15
Per cent. digested,	85.97	48.68	80.90	–	92.04	66.46
Average per cent. for both sheep,	88.28	29.50	81.79	–	93.49	64.35

Average nutritive ratio of rations for two sheep, 1: 7.4.

Feed Barley Meal. — Period XVI.

Paige Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
550 grams English hay fed,	491.43	33.17	60.10	164.38	219.52	14.25
250 grams feed barley fed,	222.68	7.28	32.51	13.78	164.56	4.54
Amount consumed,	714.11	40.45	92.61	178.16	384.08	18.79
203.20 grams manure excreted,	188.89	23.61	26.18	43.60	87.76	7.74
Grams digested,	525.22	16.84	66.43	134.56	296.32	11.05
Minus hay digested,	321.79	14.79	36.98	121.33	141.50	7.15
Feed barley digested,	203.43	2.05	29.45	13.23	154.82	3.90
Per cent. digested,	91.36	28.16	90.06	96.01	94.08	85.90

Feed Barley Meal — Concluded.

Paige Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Amount consumed as above,	714.11	40.45	92.61	178.16	384.08	18.79
215 grams manure excreted,	199.52	22.23	27.65	50.66	91.28	7.70
Grams digested,	514.59	18.22	64.95	127.50	292.80	11.09
Minus hay digested,	321.79	14.79	36.98	121.33	141.50	7.15
Feed barley digested,	192.80	3.43	27.97	6.17	151.30	3.94
Per cent. digested,	86.58	47.12	86.10	44.78	91.94	86.78
Average per cent. for both sheep,	88.97	37.64	88.08	70.40	93.01	86.34

Average nutritive ratio of rations for two sheep, 1:6.8.

Summary of Coefficients.

Food.	Sheep and Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Early Amber Sorghum.	Paige Sheep IV.,	69.36	42.98	45.36	71.72	74.04	60.39
	Paige Sheep V.,	67.37	40.45	50.91	65.22	73.35	65.10
	Average,	68.37	41.72	48.14	68.47	73.70	62.75
Pride of the North corn fodder.	Old Sheep II.,	71.89	40.06	64.45	66.50	77.76	78.37
	Old Sheep III.,	69.22	28.81	61.03	63.14	76.32	73.75
	Average,	70.56	34.43	62.74	64.82	77.04	76.06
Porto Rico molasses.	Paige Sheep IV.,	107.09	92.16	40.43	–	102.76	–
	Paige Sheep V.,	90.93	80.02	10.17	–	95.80	–
	Average,	99.01	86.09	25.30	–	99.28	–
Porto Rico molasses.	Paige Sheep IV.,	91.89	47.38	–	–	95.35	–
	Paige Sheep V.,	88.21	57.74	–	–	95.30	–
	Average,	90.05	52.56	–	–	95.33	–
English hay,	Paige Sheep IV.,	66.05	43.76	60.86	75.44	64.85	49.88
	Paige Sheep V.,	64.90	45.44	62.20	72.18	64.06	50.51
	Average,	65.48	44.60	61.53	73.81	64.46	50.20
English hay,	Old Sheep II.,	69.38	51.01	63.20	78.04	68.29	55.21
	Old Sheep III.,	66.36	47.33	61.41	74.55	65.56	49.53
	Average,	67.87	49.17	62.31	76.30	66.39	52.37

Summary of Coefficients — Concluded.

FOOD.	Sheep and Number.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Gluten feed, .	Paige Sheep IV.,	93.78	78.07	89.26	123.46	93.42	75.70
	Paige Sheep V., .	97.83	98.67	92.91	128.92	97.03	79.68
	Average, . .	95.81	88.37	91.09	126.19	95.23	77.69
Porto Rico molasses.	Paige Sheep IV.,	76.50	64.12	–	–	86.93	–
	Paige Sheep V., .	72.53	65.25	–	–	84.80	–
	Average, . .	74.52	64.69	–	–	85.87	–
English hay, .	Young Sheep I., .	66.04	50.60	63.15	72.68	65.01	53.17
	Young Sheep II.,	66.75	52.31	60.43	74.87	65.29	55.64
	Young Sheep III.,	64.98	52.95	62.37	71.05	63.68	53.88
	Average, . .	65.92	51.95	61.98	72.87	64.66	54.23
Green Diamond sugar feed.	Old Sheep III., .	69.58	38.91	71.52	51.76	78.42	91.65
	Paige Sheep IV.,	61.49	36.41	67.61	35.79	70.36	75.49
	Average, . .	65.54	37.66	69.57	43.78	74.39	83.57
Sea Island cotton-seed meal.	Paige Sheep IV.,	60.21	80.34	77.14	–	73.02	99.74
	Paige Sheep V., .	75.69	88.79	80.04	40.32	83.34	100+
	Average, . .	67.95	84.56	78.39	40.32	78.18	100.00
Red wheat meal,	Young Sheep I., .	88.15	25.79	68.49	40.05	93.98	80.65
	Young Sheep III.,	83.41	29.37	65.70	–	90.96	79.29
	Average, . .	85.78	27.58	67.10	–	92.47	79.97
Leaming corn silage.	Old Sheep II., .	67.82	45.58	58.89	68.33	71.38	82.97
	Old Sheep III., .	72.22	54.08	68.93	73.71	74.40	86.31
	Average, . .	70.02	49.83	63.91	71.02	72.89	84.64
White winter wheat meal.	Young Sheep I., .	90.58	10.31	82.68	77.39	94.93	62.24
	Young Sheep III.,	85.97	48.68	80.90	–	92.04	66.46
	Average, . .	88.28	29.50	81.79	–	93.49	64.35
Feed barley meal.	Paige Sheep IV.,	91.36	28.16	90.06	96.01	94.08	85.90
	Paige Sheep V., .	86.58	47.12	86.10	44.78	91.94	86.78
	Average, . .	88.97	37.64	88.08	70.40	93.01	86.34

Discussion of the Results.

Early Amber Sorghum. — This seed was sown broadcast May 25 at the rate of 60 pounds to the acre, and the crop was cut for soiling. It made a satisfactory growth, yielding at the rate of 19 tons to the acre. The digestion trial began August 13, as the sorghum was heading out, and the fæces were collected August 20 to 26, when the plants were fully headed and the seed forming, at which period it is probably at its best for soiling purposes.

Summary of the Coefficients (Per Cent.).

Period I.

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., . . .	1	1	69.36	42.98	45.36	71.72	74.04	60.39
Paige Sheep V., . . .	1	1	67.37	40.45	50.91	65.22	73.35	65.10
Average, ...	1	2	68.37	41.72	48.14	68.47	73.70	62.75
Barnyard millet for comparison.	3	6	70.00	56.00	65.00	73.00	71.00	58.00
Corn fodder (immature) for comparison.	5	14	68.00	42.00	66.00	65.00	71.00	68.00

The two trials with the sheep agree quite well with each other, and likewise with millet and corn fodder at a similar stage of growth. The protein only seems to be less digestible than that contained in the other two fodders. Sorghum is eaten well by dairy cattle, is available just before corn is sufficiently mature to be at its best, and is considered a satisfactory addition to the list of soiling crops for Massachusetts. A fuller discussion of the merits of this plant for soiling will be presented later.

Pride of the North Dent Corn Fodder. — The samples were taken from a large field of exceptionally thrifty and well-eared fodder. The stalks were quite stout and the ears fully developed. Sampling was begun September 5, and the fæces were collected September 13 to 19, at which time the grain was in the dough and denting. The entire plant was cut fine before being fed. It contained 77.4 per cent. water and 8.83 per cent. protein in dry matter.

Summary of the Coefficients (Per Cent.).

Period II.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep II., ...	1	1	71.89	40.06	64.45	66.50	77.76	78.37
Old Sheep III., ...	1	1	69.22	28.81	61.03	63.14	76.32	73.75
Average, ...	1	2	70.56	34.43	62.74	64.82	77.04	76.06
Average all experiments, Dent corn fodder for comparison.	9	17	68.00	34.00	53.00	57.00	73.00	74.00

The two sheep consumed the fodder readily, suffered no digestion disturbances and gave closely agreeing results. The average coefficients secured with the two sheep agree as closely as could be expected with the average of all results for mature Dent fodder. The present experiment shows in a very satisfactory manner the degree of digestibility of an excellent variety of Dent fodder that will mature in Massachusetts.

Porto Rico Molasses. — Molasses from Porto Rico has been freely offered in Massachusetts for cattle feeding at a cost of 13 cents a gallon of 12 pounds in barrel lots. The material, while dark colored, was of a satisfactory quality. It contained 20 to 28 per cent. of water (about 24 per cent. average), and in its natural condition about 3 per cent. of crude protein (largely amids), 6.3 per cent. of ash, and the balance cane and invert sugars and allied substances (extract matter). It can be safely assumed that molasses, being quite soluble in water, is easily digested and resorbed in the digestive tract. Three digestion experiments were made by feeding different quantities of the molasses in combination with hay, and hay and gluten feed, in order to note its effect upon the digestion of the other feed stuffs.[1]

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[1] It is a well-known fact that the addition of excessive quantities of starch and sugar causes a distinct depression in digestibility of the other feed stuffs. See summary in Kellner (already cited), page 48.

Summary of the Coefficients (Per Cent.).

Period III.

[800 grams hay, 150 grams molasses and 10 grams salt.]

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	107.09	92.16	40.43	-	102.76	-
Paige Sheep V., ...	1	1	90.93	80.02	10.17	-	95.80	-
Average, ...	1	2	99.01	86.09	25.30	-	99.28	-

The results show that apparently Sheep IV. digested rather more, and Sheep V. some 9 per cent. less, than the quantity fed. The average coefficients for the two sheep indicate that the dry matter of the molasses was fully digested. It is probably true, however, that in case of Sheep IV. the addition of 150 grams of molasses to the hay ration increased the digestibility of the dry matter of the hay some 7 per cent., and in case of Sheep V. decreased the digestibility of the hay about a like amount. The results can be still further explained by the following figures: —

Sheep IV.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Digested of 800 grams hay fed alone (grams).	408.87	23.43	32.85	133.86	210.30	8.12
Digested of 800 grams hay + 150 grams molasses.	523.71	31.78	34.56	141.89	306.85	8.54
Minus 150 grams molasses fed, assumed to be all digested (grams).	107.24	9.06	4.23	-	93.95	-
Leaves for 800 grams hay digested when fed with molasses.	416.47	22.72	30.33	141.89	212.90	8.54
Difference, ...	+7.60	—.71	—2.52	+8.03	+2.60	+.42

It will be seen that in case of Sheep IV. the feeding of 150 grams of molasses with 800 grams of hay increased the digestibility of the hay 7.6 grams. By this method of feeding the digestibility of the fiber, extract matter and fat in the hay was increased 11.05 grams and the digestibility of the ash and protein depressed 3.23 grams. If 150 grams of molasses increased the digestibility of the hay 7.32 grams (7.60), 100 grams of molasses would increase it 5.1 grams.

Sheep V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Digestion of 800 grams hay fed alone (grams).	408.87	23.43	32.85	133.86	210.30	8.12
Digested of 800 grams hay + 150 grams molasses (grams).	506.38	30.68	33.28	133.82	300.30	8.31
Minus 150 grams molasses fed assumed to be all digested (grams).	107.24	9.06	4.23	-	93.95	-
Leaves for 800 grams hay digested when fed with molasses.	399.14	21.62	29.05	133.82	206.35	8.31
Difference, ...	—9.73	—1.81	—3.80	—.04	—3.95	+.19

Sheep V. digested 9.36 (9.73) grams less hay when the latter was fed with the molasses than when it was fed alone, or 100 grams of molasses caused a depression of 6.05 grams in the digestibility of the hay. The results secured in this particular experiment (Period III.) are contradictory, and definite conclusions cannot be drawn other than to conclude that this quantity of molasses was well assimilated, without causing any serious digestion depression.

Period IV.

[800 grams hay + 250 grams molasses + 10 grams salt.]

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	91.89	47.38	-	-	95.35	-
Paige Sheep V., ...	1	1	88.21	57.54	-	-	95.30	-
Average, ...	1	2	90.05	52.56	-	-	95.33	-

It seems apparent that 90 per cent. of the total dry matter of the molasses was digested, equivalent to one-half of the ash, none of the protein and 95 per cent. of the extract matter. That these results are more apparent than real can be shown from the following: —

Average, Sheep IV. and V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Digested of 800 grams hay fed alone (grams).	404.56	23.19	32.51	132.44	208.07	8.03
Digested of 800 grams hay + 250 grams molasses (grams).	566.92	31.20	32.04	136.99	358.65	8.06
Minus 250 grams molasses fed, assumed to be all digested (grams).	180.30	15.24	7.10	-	157.96	-
Leaves for 800 grams hay digested when fed with molasses.	386.62	15.96	24.94	136.99	200.69	8.06
Difference, ...	−17.94	−7.23	−7.57	+4.55	−7.38	+.03

The average results for the two sheep show that 17.94 (17.60) grams less hay were digested when 250 grams of molasses were fed than when the hay was fed by itself; or 100 grams of molasses caused a depression of 7.2 grams in the digestibility of the dry matter of the hay. The molasses depressed the digestibility of the ash, protein and extract matter of the hay. Excluding the ash, 100 grams of molasses caused a depression of 4.1 grams in the digestibility of the organic matter of the hay. Molasses and hay naturally would not make a satisfactory combination for any kind of farm stock. A more suitable ration would consist of hay, a protein concentrate and molasses; consequently, the digestibility of the latter was tested in combination with hay and gluten feed, with the following results: —

Period VIII.

[600 grams hay, 200 grams gluten feed, 250 grams molasses, 10 grams salt.]

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	76.50	64.12	-	-	86.93	-
Paige Sheep V., ...	1	1	72.53	65.25	-	-	84.80	-
Average, ...	1	2	74.52	64.59	-	-	85.87	-

It is apparent from the above results that the sheep digested only some 75 per cent. of the total dry matter of the molasses. By assuming that the entire quantity of molasses fed was digested, the following results are secured: —

Average, Sheep IV and V.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Digested of hay and gluten feed when fed *without* molasses (grams).	524.97	18.75	81.88	148.40	264.22	11.74
Digested of hay and gluten feed fed with molasses.	660.31	29.58	79.47	139.96	399.66	11.61
Minus 250 grams molasses fed, assumed to be all digested (grams).	181.68	16.75	7.16	-	157.77	-
Hay and gluten feed digested when fed *with* molasses (grams).	478.63	12.83	72.31	139.96	241.89	11.61
Difference, ...	—46.34	—5.92	—9.57	—8.44	—22.33	—.13

The average results for the two sheep show that 46.34 grams less of the dry matter of the hay and gluten feed were digested with than without the molasses; or 100 grams of molasses caused a depression of 18.5 grams in the digestibility of the hay and gluten ration. Excluding the ash, 100 grams of molasses caused a depression of 3.8 grams protein and 12.3 non-protein substances.

When 250 grams of molasses were fed in connection with hay, the digestion depression for organic matter was at the rate of 4 grams per 100 grams molasses; and when fed in connection with hay and a nitrogenous concentrate, the digestion depression was 16.1 grams. It is intended to repeat the latter experiment by feeding different quantities of molasses with hay and gluten feed, in order to see if the depression continues as high as that observed in the present test.

The average of three complete analyses of Porto Rico molasses has shown it to contain, in round numbers, 24 per cent. of water, 6.25 per cent. ash, 2.75 per cent. protein and 67 per cent. carbohydrates. Inasmuch as the so-called protein is practically all in amido or other forms which are of no value as sources of nutrition, it may be said that the food value of molasses consists in its 67 per cent. of carbohydrates. Applying the digestion coefficient of 86, obtained for the digestibility of the extract matter when the molasses was fed in combination with hay and gluten feed, one obtains 58 per cent. of digestible carbohydrates, equivalent to 1,160 pounds in a ton.

By deducting 16 grams, or 16 pounds (for the digestion depression), from the 70 per cent. of total organic matter, molasses may be said to contain 54 per cent. of digestible organic matter, equivalent to 1,080 pounds in a ton. In the light of the above results, it is evident that 2,000 pounds of Porto Rico molasses contain between 1,080 and 1,160 of easily digestible carbohydrates, and that its crude protein has little or no value as a source of nutrition.[1]

Kellner[2] considers the value of beet sugar molasses to consist in its 55 per cent. of digestible carbohydrates, allowance being made for the digestion depression. Lehmann,[3] as a result of three digestion experiments (9 single trials), feeding hay, cotton-seed or palm-nut meal, and 200, 300 and 400 grams of molasses, secured a digestion depression of 11 per cent., or 11 grams, per 100 grams of molasses fed. Deducting this from the 71 per cent. of organic matter, he declares the value of the beet molasses to consist in its 60 per cent. of digestible carbohydrates.

English Hay. — This hay consisted largely of Kentucky blue grass (*Poa pratensis*), with an admixture of more or less red clover. It was cut when in bloom, well cured, and used in periods V., VI., VII., VIII., IX., XI., XII., XIII., XIV., XV. and XVI.

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[1] One is not likely to feed over 3 pounds of molasses daily to dairy stock or to horses, which is equivalent to approximately 10 per cent. of the dry matter of the total ration. In our digestion experiment with hay and gluten feed, molasses constituted 20 per cent. of the dry matter of the ration; and in Lehmann's experiments, 25 per cent. If only 10 per cent. of the total dry matter in the daily ration should consist of molasses, the question naturally arises as to whether this amount would cause so much of a depression as when larger quantities were fed. This matter is being investigated.

[2] Kellner (already cited), page 350.

[3] Landw. Jahrbücher, Vol. XXV. Erganzungsband 11, 1894, pages 117-120.

Summary of the Coefficients (Per Cent.).

Periods V., VI., IX.

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	66.05	43.76	60.86	75.44	64.85	49.88
Paige Sheep V., ...	1	1	64.90	45.44	62.20	72.18	64.06	50.51
Average, ...	1	2	65.48	44.60	61.53	73.81	64.46	50.20
Old Sheep II., ...	1	1	69.38	51.01	63.20	78.04	68.29	55.21
Old Sheep III., ...	1	1	66.36	47.33	61.41	74.55	65.56	49.53
Average, ...	1	2	67.87	49.17	62.31	76.30	66.39	52.37
Young Sheep I., ...	1	1	66.04	50.60	63.15	72.68	65.01	53.17
Young Sheep II., ...	1	1	66.75	52.31	60.43	74.87	65.29	55.64
Young Sheep III., ...	1	1	64.98	52.95	62.37	71.05	63.68	53.88
Average, ...	1	3	65.92	51.95	61.98	72.87	64.66	54.23
Average, seven sheep, . .	1	7	66.35	49.05	61.95	75.55	65.10	52.55
Average all previous trials, similar hay for comparison.	15	60	60.00	47.00	57.00	60.00	61.00	50.00

The three lots of sheep digested the hay quite uniformly. The Old Sheep gave slightly higher digestion coefficients than the other two lots, — a condition which has been noticed in previous trials. The hay proved to have a higher digestibility than the average of previous lots; the high digestibility of the fiber indicates that the lignin substances were only slightly developed, or, in other words, that the grass was tender and comparatively immature.

Gluten Feed. — The sample of gluten feed, consisting of the gluten, skins, starchy matter and broken germs of the Indian corn, was in good condition, although a little below the average in protein.

Summary of Coefficients (Per Cent.).

Period VIII.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., . . .	1	1	93.78	78.07	89.26	123.46	93.42	75.70
Paige Sheep V., . . .	1	1	97.83	98.67	92.91	128.92	97.03	79.68
Average, ...	1	2	95.81	88.37	91.09	126.19	95.23	77.69
Average previous trials for comparison.	7	13	86.00	–	85.00	76.00	89.00	83.00

The gluten feed appears to have been thoroughly digested, showing higher coefficients than the average of previous trials. It is probable that the addition of the gluten to the hay ration somewhat increased the digestibility of the latter. It not being possible, however, to ascertain to what extent this increase took place, one is compelled to deduct from the total ration the hay digested (using the coefficients obtained for the hay when fed by itself), thus causing most of the gluten coefficients to appear too high [1] (note especially the fiber).

Green Diamond Sugar Feed. — This sugar feed has a similar appearance and is of the same general type as those already reported (see this report, pages 119, 120). Period X. started with two sheep, but the fæces produced by one sheep were so soft that it was not possible to complete the test. Another trial with another sheep was also unsatisfactory. A third trial, in Period XIV., with Paige Sheep IV., was satisfactorily completed.

Summary of Coefficients (Per Cent.).

Periods X. and XIV.

Sheep.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep III., ...	1	1	69.58	38.91	71.52	51.76	78.42	91.65
Paige Sheep IV., . . .	1	1	61.49	36.41	67.61	35.79	70.36	75.49
Average, ...	1	2	65.54	37.66	69.57	43.78	74.39	83.57
Average of three other sugar feeds (Series X.).	3	6	70.44	30.37	61.77	53.30	78.40	88.20
Average all trials, . . .	4	8	69.21	32.20	63.72	50.92	77.40	87.04

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[1] The addition of a concentrated feed rich in protein tends to improve the digestibility of the total ration, especially the fiber. (See Kellner, *loco citato*, pages 51–53.)

Sheep III. digested the feed rather better than Sheep IV. Attention has already been called to the fact that the Old Sheep had a slightly stronger digestion than the others, but why the difference should be so noticeable is difficult to explain.

The protein in the sample of Green Diamond experimented with was better digested than that in the several other sugar feeds. The results secured with Sheep III. and the average results of all trials agree closely; and it may safely be said that this feed has about the same type of composition and a like degree of digestibility as the other sugar feeds examined. The average results of all trials show the sugar feeds to be only moderately digestible, being noticeably less so than either flour middlings or gluten feed.

Sea Island Cotton-seed Meal. — This meal contained a large quantity of hulls, showing only 24–25 per cent. of protein, 5–6 per cent. of fat and some 18 per cent. of fiber. It is claimed that the hulls of this variety of seed are thin, and that it is not possible (or profitable) to thoroughly separate them from the meats.

Summary of Coefficients (Per Cent.).

Period XI.

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Paige Sheep IV., ...	1	1	60.21	80.34	77.14	–	73.02	99.74
Paige Sheep V., ...	1	1	75.69	88.79	80.04	40.32	83.34	100+
Average, ...	1	2	67.95	84.56	78.59	40.32	78.18	100.00
Similar material (Maine), .	1	2	62.00	–	73.00	38.00	68.00	90.00
Cotton-seed meal (high grade),	4	12	79.00	84.00	84.00	35.00	78.00	94.00

Sheep IV. was not able to digest the meal as fully as was Sheep V. The cause of this difference is due largely to the indigestible character of the tough, woody fiber. The coefficients secured at the Maine station for a similar meal are somewhat lower than those obtained in the present experiment.

The fat in the low-grade meal is shown to be nearly all available, while the protein is somewhat less digestible than that contained in a high-grade meal; the chief difference, however, in the digestibility of the two grades is to be found in the total dry and extract matter, decidedly lower coefficients being secured from the low-grade meal containing a high fiber percentage. Cotton-seed meal of first quality should contain in 2,000 pounds about 700 to 760 pounds protein, 44 pounds fiber, 380 pounds extract matter and 192 pounds fat, or 1,346 pounds digestible organic matter in one ton. A low-grade meal will contain 380 pounds protein, 144 pounds fiber, 540 pounds extract matter and 142 pounds fat, or 1,206 pounds digestible organic matter in a ton. The low-grade meal contains only about one-half as much of the most valuable ingredient (digestible protein) as does the high-grade meal. The former meal will likewise require considerably more energy for its digestion.

Leaming Corn Silage. — The Leaming corn is a large dent, that will usually mature its grain in Massachusetts. The silage was in nice condition, and was made from matured and well-eared corn. The sheep ate the silage well, continued in good condition, and during the entire trial left only 25 and 40 grams each of the hard butts.

Period XIII.

[400 grams hay, 1,600 grams silage, 10 grams salt.]

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Old Sheep II., ...	1	1	67.82	45.58	58.89	68.33	71.38	82.97
Old Sheep III., ...	1	1	72.22	54.08	68.93	73.71	74.40	86.31
Average, ...	1	2	70.02	49.83	63.91	71.02	72.89	84.64
Dent silage, mature, all trials for comparison.	9	25	66.00	37.00	50.00	64.00	71.00	82.00

The two sheep showed closely agreeing results except in case of the protein, Sheep III. digesting 10 per cent. more than Sheep II. The Leaming corn is highly esteemed by many farmers for silage purposes; and the fact that it will generally mature its grain, together with its high degree of digestibility, as shown by the above coefficients, shows the preference to be a wise one. The average results of the two trials are rather higher than the general average of all experiments with different varieties of Dent corn.

Red and White Wheat and Barley Meals. — The several grains were purchased of local dealers. Neither variety of wheat was suitable for milling; the former contained some shrunken berries and a few weed seeds, and the latter, while fairly plump, was off color. The barley was known as "feed barley;" it was not plump and full, and was a trifle musty. The grains were sold as food for poultry, and may be considered of a fairly satisfactory quality for such a purpose. The red wheat retailed at $1.65, the white at $1.80 and the barley at $1.30 per hundred pounds. The analyses and the digestion trials were made for the purpose of ascertaining their relative values for feeding purposes.

Composition (Per Cent.).

Feed.	Water.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Red wheat, ...	12	1.69	8.76	2.64	72.45	2.46
White wheat, ...	12	1.67	11.50	2.11	70.84	1.90
Feed barley, ...	11	2.91	12.99	5.52	65.78	1.80

Each of the two samples of wheat contained a trifle less than 12 per cent. water, and the results were therefore calculated to that basis for comparison. The white wheat tested a little better than the red, containing nearly 3 per cent. more protein and a little less fiber. It is doubtful, however, if these figures would hold true in all cases. In fact, it is well known that both climate and soil have great influence on the quality of wheat and gradually modify varieties.

The barley showed rather more protein than is usually found in this grain. It is probable that it had not been fully ripened when cut, thus preventing the most complete development of the starch.

Summary of Coefficients (Per Cent.).

Periods XII., XV. and XVI.

[Red Wheat.]

SHEEP.	Number of Different Lots.	Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Young Sheep I.,	1	1	88.15	25.79	68.49	40.05	93.98	80.65
Young Sheep III.,	1	1	83.41	29.37	65.70	–	90.96	79.29
Average,	1	2	85.78	27.58	67.10	–	92.47	79.97
[White Wheat.]								
Young Sheep I.,	1	1	90.58	10.31	82.68	77.39	94.93	62.24
Young Sheep III.,	1	1	85.97	48.68	80.90	–	92.04	64.35
Average,	1	2	88.28	29.50	81.79	–	93.49	63.30
Average, both varieties,	2	4	87.03	28.54	74.44	–	93.00	71.30
[Feed Barley.]								
Paige Sheep IV.,	1	1	91.36	28.16	90.06	96.01	94.08	85.90
Paige Sheep V.,	1	1	86.58	47.12	86.10	44.78	91.94	86.78
Average,	1	2	88.97	37.64	88.08	76.40	93.01	86.34
Corn for comparison,	9	21	88.00	–	66.00	–	92.00	91.00

The grains were ground in each case before being fed. Both varieties of wheat were well digested; the white wheat appeared to have been slightly better digested than the red. The barley was likewise quite fully digested, showing 89 per cent. of digestible dry matter and 88 per cent. of digestible protein. The ratio of digestible protein to carbohydrates in the red wheat was 1 to 9; in the white wheat, 1 to 7.4; and in the barley, 1 to 6.8. The increased digestibility of the protein in the white wheat and feed barley over that contained in the red wheat is due probably to the relatively higher percentage of protein in the latter two grains, and consequently in the two total rations.[1] It is believed that the protein in ordinary grains (maize, wheat and barley) is equally and quite fully digested, providing it is fed in a ration having a ratio of 1 to 8 or less; and that the apparent low coefficient (see present red wheat protein coefficient, and average protein coefficients for maize) is due largely to the above-mentioned cause.[1] A further study of the coefficients of wheat, barley and corn, as given on the previous pages, shows the extract matter to have practically the same degree of digestibility.[2]

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[1] For every 100 grams of dry matter fed, a reasonably definite amount of nitrogenous metabolic by-products are egested, mixed with the fæces, whether the ration is rich or poor in protein. It follows, therefore, that the smaller the amount of protein in the total ration the smaller will be the amount of protein left (digested) after these by-products which are included in the fæces have been deducted.

On the basis of composition and of the digestion coefficients secured, the white variety of wheat is shown to be some 9 per cent. more valuable than the red. Whether this would hold true as a general rule is not known. Other things being equal, the higher the protein content of the wheat the more valuable it is.

Taking the value of all the ingredients into consideration (protein, fiber, extract matter and fat), an average quality of "feed barley" appears to be about as valuable as an average quality of white wheat, and both grains figure slightly more valuable than maize (8 per cent.). Kellner[3] considers these three grains to have very nearly equal relative values, and as sources of carbohydrates this estimate must be correct. Brooks[4] has called attention to the fact that, with a plentiful supply of animal protein, corn gives rather better results than wheat for egg production, and at less relative cost. In view of their composition and digestibility, it would seem as if there were no reason to expect any particular difference in the feeding effect of these two grains. It is possible, however, that the energy required for the digestion of the wheat might be greater than that required to digest the corn. It is well known that poultry are particularly fond of corn and moderately so of wheat, but do not care especially for barley. This fact should not be overlooked in comparing the relative merits of corn, wheat and barley for this class of stock.

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[1] For every 100 grams of dry matter fed, a reasonably definite amount of nitrogenous metabolic by-products are egested, mixed with the fæces, whether the ration is rich or poor in protein. It follows, therefore, that the smaller the amount of protein in the total ration the smaller will be the amount of protein left (digested) after these by-products which are included in the fæces have been deducted.

[2] The digestion experiments thus far made with poultry show the dry matter in corn to be 87, protein 84 and extract matter 92 per cent. digestible; and in wheat dry matter 84, protein 77 and extract matter 89 per cent. digestible. In other words, poultry digest the two grains to about the same extent as sheep.

[3] *Loco citato*, page 561.

[4] Eighteenth report of this station, page 152.

REPORT OF THE BOTANIST.

G. E. STONE; ASSISTANT, N. F. MONAHAN.

Outline of Work.

The work of this department has been devoted during the past year to lines of investigation pertaining to scientific and practical problems. Attention has been given to the spraying of potatoes, and to a study of the stimulating or tonic influence of the Bordeaux mixture on the photosynthesis of plants. It has long been recognized by many observers that Bordeaux mixture, besides possessing valuable fungicidal properties, exerts a tonic effect on plant assimilation. The factors underlying the cause of this favorable influence upon assimilation, however, are not well understood, and investigations are to be continued relating to this problem.

A continuation of our studies of a remedy for tomato rot under glass has been carried on, and it will be necessary to continue these investigations still further before a report is made. It is hoped that the necessary funds for a new greenhouse will be appropriated this winter by the Legislature, in order that this work and other problems associated with greenhouse culture may be investigated. There is a large amount of money invested in greenhouses at the present time in Massachusetts, and we believe we are within the limits of safety when we state that the square feet of greenhouse space in Massachusetts has been doubled within the past five years. Little attention has been given to this line of investigation by other stations, and the market-garden and florist industry is important enough, in this State at least, to receive considerable attention.

During the past summer tests have been made of some blight-resisting cantaloupes which were originated in Colorado. It is hoped that further observations may be made on cantaloupes, with the idea of securing blight-resisting types, since at the present time crops of melons free from blight are a rarity in Massachusetts.

Some bacterial investigations have been carried on which possess a bearing on various problems, but it is not deemed advisable to report on this work at the present time.

This also holds true in regard to some minor experiments with electricity as related to plants. Extensive observations have been made in regard to the bearing of light upon plant growth, more particularly in regard to greenhouse construction and other problems.

During the coming year we expect to take up the study of some climatic influences which affect the production of both greenhouse and out-door crops. The production of crops is so intimately associated with such factors as light, heat, moisture, etc., — factors which are scarcely appreciated except by skilled greenhouse growers, — that a more extensive study of them would prove of value.

During the year a large number of mechanical analyses of soils have been made by this department, most of which were rose soils. These analyses were made for expert rose growers, who desired to secure suitable soils for the growth of American Beauty and other roses.

Seed Work.

There is a constantly increasing demand upon this department for work pertaining to seed germination, seed separation and purity testing of seeds. The department is not at present sufficiently well equipped for purity testing, since the best work in this line can be done only by a specialist, or by one who is able to devote considerable study to the subject.

Most of our seed separation is done for tobacco and onion growers of the Connecticut valley, and for this work the department has installed efficient appliances. It is hoped that market gardeners will eventually separate their seed, since in growing such crops as lettuce, celery, radishes, etc., this practice would prove valuable.

The following table gives a condensed statement of the work done by this department on seeds during the year: —

Records of Seed Work for 1906.

	Number of Samples.	Number of Seed.	Weight (Pounds).	Good Seed (Per Cent.).	Discarded Seed (Per Cent.).
Germination tests,	126	19,567	-	58.8	-
Purity test,	18	-	-	-	-
Seed separation: —					
Onion,	13	-	129.6	83.8	16.2
Tobacco,	74	-	24.1	80.3	19.7
Total,	231	-	-	-	-

The average percentage of germination of onion seed was 79.5; of sweet corn, 71.9; and the highest percentage of onion seed germination was 100, while the same percentage was obtained with samples of sweet corn. The lowest percentage of germination of onion was 28; that of sweet corn, 25. In practically all cases 200 seeds were employed in each test, and smaller numbers were used only when the number of seeds sent in was less. Occasionally more than one test was made, and the average in such cases was taken. The onion seeds tested during 1906 were particularly good, being much better than those we have tested during previous years. Both onion and tobacco seed were separated by air. Only 2 per cent. of seed was discarded by the process of air separation from the best tobacco seed sent in, while from the poorest samples 37 per cent. was discarded. In the case of the best onion seed, 8 per cent. was discarded by the use of a winnowing machine, while only 20 per cent. was discarded from the poorest samples of onion seeds.

PREVALENCE OF FUNGI, ETC.

One of the peculiarities of the different seasons is that no two are alike as regards the prevalence of certain pathogenic fungi. The potato has been comparatively free from disease during the past season; but there was more or less trouble with celery, particularly in the summer, when there was a period of rather dry weather; and later in the fall there was much complaint of celery blight. Pear and apple blight were unusually prevalent this year, more so than they have been for some time. An unusually large number of samples of pear and apple blight were sent in to the station for diagnosis during the spring and early summer. More or less defoliation of apple trees has occurred, resulting in part from the late spring frosts, which caused blisters on the leaves; and from the use of spraying mixtures.

A considerable amount of trouble is being experienced in the defoliation of apple trees at the present time in various parts of the United States, which is presumably caused by spraying. Some of this trouble is to be found in our State, and we surmise that it may be due in some cases to the use of inferior Paris green in Bordeaux mixture, and in other cases to the Bordeaux itself. The Baldwin apple spot has been more or less prevalent during the past season, and some trouble has been experienced from apple scab.

A widely distributed and common trouble has occurred on apple trees during the past season, which is termed sun scald. This was more noticeable on small branches, particularly on those which were shaded. This same diseased condition was noticeable on other fruit trees, such as the peach and plum; and on some wild shrubs, like the cornels. The effect of sun scald was in some instances of an insignificant nature; while in others it resulted in a partial girdling of some of the branches, which was followed by a poor development of the foliage, and in some cases many of the twigs died.

Sun scald is the result of a non-ripening of the wood; and it is significant that most of the branches affected with this trouble are those hidden from the sun, which prevents the wood from ripening as thoroughly as those which are exposed to the sun.

For the last two or three years sooty mold on the pear has given rise to considerable trouble. This is caused by fungi which grow in the honey-dew secreted by psylla on the leaves and branches. As a consequence of this fungous growth, there results a clogging of the pores of the leaves, which renders them unhealthy, causing them to fall prematurely. The young twigs and branches become covered with a thick black growth, resembling soot, which interferes with their normal functions, thus checking their growth. A satisfactory way of ridding the branches of this sooty growth is not known to us at the present time, and from reports which we have received it would appear that the lime and sulfur treatment has no effect upon it. The best method of prevention is to kill the psylla, which can be effectively done by spraying.

Some incidental observations have been made during the year on diseases which are unusual, at least in this region; and these will be referred to briefly, since it is necessary that further studies of these be made before it can be ascertained whether they are likely to cause much trouble. Our attention has been called a few times to some greenhouse tomato troubles, one of which is probably the Fusarium wilt, or "sleeping disease," as it is termed, — a trouble which has been reported elsewhere.

Another tomato trouble which has been brought to our attention is probably identical with Œdema, and is caused by abnormal heat and moisture conditions. In another case a bacterial trouble of the tomato was observed which was undoubtedly brought about by the exceedingly poor management of the crop.

Two new or little-known asparagus troubles were noticed during the past season, one of which is undoubtedly a Rhizoctonia rot, which is mentioned as occurring on asparagus by Saccardo. We were not able to make an elaborate study of this asparagus infection, owing to the limited amount of material which was at hand. Most Rhizoctonia troubles are serious, and it remains to be seen whether this will prove to be so or not.

Bacterial Disease of Cucumbers.

The bacterial disease of cucumbers, termed by Dr. Erwin R. Smith "bacteriosis," has been seen here in summer for some years on out-door cucumber crops. My attention, however, has not been called to its appearance on greenhouse crops until this year; but if the reports and descriptions of this disease are correct, it has occurred in more than one greenhouse during the year.

In only one case have we had opportunity to examine an affected crop, and this was totally destroyed during October. This crop was started in August, and, like most crops of cucumbers started in midsummer, it was affected with downy mildew (*Plasmopara Cubensis,* B. & C., Humphrey). The soil in the house was of good texture for cucumbers, and well provided with horse manure and commercial fertilizers, as was evident from the vigorous growth of the plants. About the time the plants had reached a height of seven or eight feet and had set a large amount of fruit the leaves commenced to wilt, and in a few days most of the foliage collapsed, leaving only a few unaffected leaves at the top of the plant, which necessitated the removal of the entire crop. Adjacent to this greenhouse were other larger houses, which, however, were planted somewhat later, and the plants in these houses entirely escaped infection.

Bacteriosis of cucumbers has been rare, if it has occurred at all, under glass in this State. A few years ago we secured germs from an affected out-door crop of cucumbers, and inoculated the soil in our greenhouse in which cucumbers were growing, with the result that not the slightest infection occurred in any instance. The experiment was made during the fall and winter months, which may account in part for the failure of the germs to infect the plants.

There is always risk in planting a cucumber house in August, since the downy mildew previously mentioned, and Anthracnose (*Colletotrichum Lagenarium* (Pass.) Ell. & Hals.), are sure to be present during August in full force; and the same probably is true to a certain extent in regard to the germs of bacteriosis. At any rate, it is a significant fact that nearly every house planted late has none of these troubles to contend with.

In the case of the bacteriosis described above we are of the opinion that the method of growing the crop had something to do with its susceptibility to infection, since the plants were in our estimation somewhat too vigorous growers, and did not possess the best texture.

We have frequently advised growers of cucumbers not to plant in August, on account of mildews, etc. There is much less risk in planting in September, and scarcely any during any time in October. If a house of cucumbers is planted in August, it is necessary to ventilate freely, apply little or no water to the foliage, and keep down the moisture in the atmosphere to the lowest degree, in order to hold mildews and Anthracnose in check.

BACTERIAL DISEASE OF LETTUCE.

Our attention has been called at different times to an undescribed bacterial disease of lettuce, which is reported as causing considerable damage in some localities. This disease has been observed in our greenhouse for many years, and during the year 1901 Mr. Percival C. Brooks, then a member of the senior class in botany, investigated this problem. He succeeded in isolating an organism from a diseased lettuce plant, and obtained positive results from his inoculation experiments with healthy plants.

The disease in question has never been observed by us in this State except in our own house, notwithstanding the fact that we have for many years had occasion to carefully study the various lettuce crops in the State, and have constantly been on the lookout for it. Neither has careful inquiry brought to light any trace of a similar affection in lettuce houses in Massachusetts. Since the disease occurred in our lettuce house on crops which had been forced too rapidly, it was considered of little consequence and was given scarcely any attention, inasmuch as we thought the trouble arose from improper management of the crop. Our only purpose in calling attention to this disease at the present time is that it is reported as doing considerable damage elsewhere, particularly in the south, which makes it desirable that we should be on the lookout for it. The disease results in the appearance of numerous small brownish spots about the size of a pin-head on the young and tender light-colored leaves of the head. The spots are frequently quite numerous, and in some cases run together, causing a destruction of a portion of the leaves of the head. No attempt was made by Mr. Brooks to make any extensive study of the organisms causing the disease, since at that time it was believed to be of little consequence, and only an accompaniment of too rapid forcing. In some localities, particularly farther south, we hear different reports concerning its prevalence.

BACTERIOSIS OF GERANIUMS.

In a previous publication of this station a short note was made of a bacterial disease of geraniums occurring in this State.[1] Since that time we have made yearly observations on the prevalence of this disease in various sections. It has appeared every year since it was first noted here in 1898, and has also been reported from various other sections of the United States within recent years.

Our observations have shown that it has frequently been abundant and generally distributed, so much so at times that gardeners have been more or less concerned about it. We have also noticed this disease in greenhouses each year, it having apparently been brought in with out-door stock, although it does not appear to be serious under glass. Our observations have shown that the trouble is more frequently found on plants exposed to bright sunshine than on those growing in shade, and is evidently more severe farther south, where the light is more intense than in Massachusetts. Geraniums require comparatively little light for their best development, and a strong light may favor the development of this disease.

The disease affects the leaves, causing spots to appear on them. The spots are often numerous and sometimes coalesce, which causes the diseased portions to dry up and turn brown. The spots are about one-eighth of an inch in diameter, and resemble blisters. No other portion of the plant is affected. Examination of a large number of diseased sections shows only a few bacteria present in the tissues except in those cells bordering on the outer portions of the spots.

The geranium is a very hardy plant, and one of the freest from disease. No attempt has been made to treat this disease, to our knowledge, and should it become more troublesome some remedy for it will have to be discovered.

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[1] Tenth annual report, Hatch Experiment Station, 1898, page 67.

Tobacco Troubles.

Some troubles, due to methods of handling the crop, occasionally occur on tobacco growing in the Connecticut valley. Instances have been known for years where the crops have been set back by the use of certain fertilizers and methods of applying them. Tobacco, corn and other crops, moreover, show a tendency to stand still or make little growth on soil in which there is an overabundance of moisture.

Our attention has been called to a tobacco trouble which appears to be caused by the use of fertilizer. In one particular field which we examined the roots of the plants had all the characteristic symptoms of fertilizer burning, and careful examination failed to reveal any fungi associated with this trouble. The tap roots of all the plants which we examined had been destroyed, and new secondary roots had developed freely on the injured end of the tap root. These were endeavoring to penetrate to the lower strata of the soil, and would in turn become burned on the tip before reaching any great distance.

The effect on the crop manifested itself in a stunted growth, the plants remaining in this condition for weeks. When plants affected with this trouble were removed to other soils they would in all cases make rapid growth. Even in the field where the trouble occurred they would reach a fair degree of maturity at the time of harvesting. There appears to be absolutely no connection between this trouble and the seed bed, since other fields close by were planted from this seed bed, and not the slightest evidence of the trouble was to be seen. Moreover, it occurs on new tobacco land as well as on old. It was as severe on land which had been planted this year for the first time as it was on old land.

The trouble apparently seems to have no inclination to spread, since a field only ten or twelve feet away from the infected one, planted with seedlings from the same seed bed, showed no trace of it. It is much more conspicuous in low places which receive drainage from the surrounding soil than on the drier knolls.

At present, at any rate, the trouble must be attributed to mistakes in fertilizing, since no fungi are associated with it; and the only difference between the cultivation of this particular crop in which the trouble occurred and other surrounding ones, some of which had been planted from the same seed beds, consisted in the methods of fertilizing.

Monilia on Peach Stem.

For a number of years we have received peach twigs in this department which have been conspicuously spotted. The spots appear on one-year-old wood, and are of an ash or greyish color in the center, with a more highly colored, generally purple margin. Examination of these spots has invariably revealed the presence of a species of Monilia which extends scarcely below the epidermis. Occasionally the spores of Cladosporium are to be found, but by no means frequently. Some years the spotting appears to be much more common than others, and there is generally little difficulty in finding it in orchards during such periods. Cultures from the spots have always produced Monilia. Mr. F. A. Bartlett, now of Hampton Institute, Hampton, Va., and formerly a senior in our laboratory, during the year 1905 made many isolations and cultures of this fungus. He was not able to complete his studies of the fungus, but from his observations it would appear that a species of Monilia was the sole cause of this spotting. Mr. Bartlett thus verified observations which had been previously made by my former assistant, Prof. R. E. Smith, and myself. From Mr. Bartlett's various cultures it would appear that the spores of Monilia causing this spotting to peach twigs are not the same as those occurring on the fruit (*Oidium fructigenum*)[1] but is a different species, possessing smaller spores, and otherwise differing from the species attacking the fruit of the peach, etc.

There are various Monilia and Cladosporium troubles which affect the peach described in experiment station publications and foreign pathological journals, all of which appear to differ from this one in its effect upon twigs.

We hope to make further investigations of this trouble, and in the meanwhile it may be mentioned that where the lime and sulfur treatment has been applied to peach trees for the San José scale not the slightest trace of this spotting can be found, showing that this mixture has a very repressive influence upon the fungus.

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[1] *Oidium fructigenum*, Kze. & Schm.

THE LIME AND SULFUR MIXTURE AS A FUNGICIDE.

The increased activity of the San José scale during the past two years has resulted in more attention being paid to the spraying of orchards. This has been the means of reducing very perceptibly many of the troubles to which orchards are subject. Our examinations of a number of orchards during the past summer which had been sprayed with the lime and sulfur mixture have convinced us that this mixture is one of the most reliable fungicides known for the suppression of certain fungous diseases. It is especially applicable for the control of such diseases as the peach leaf curl, as has been previously pointed out by many observers. It is equally valuable in the treatment of Monilia and Cladosporium, which occasionally attack the stem.

The large and exceedingly well-cared-for orchard of Mr. Elbert Bliss of Wilbraham offers one of the best examples of the efficiency of the San José mixture as a fungicide. His orchard, which covers many acres, was absolutely free from any blemish due to fungi, both as regards foliage and wood. The college orchard, which was sprayed for the San José scale with the lime and sulfur mixture, has been remarkably free from fungous troubles during the past season. Our observations of other orchards have seemed to indicate that spraying with the lime and sulfur mixture succeeds in controlling to some extent canker, pear blight, black knot and other diseases. We have frequently advocated early spring spraying of trees before the leaves appear, with a solution of copper sulfate at the rate of 1 pound to 50 gallons of water, as we maintain that many of the common blights are more successfully prevented by this spraying than by later ones. It has been shown that early spraying with copper sulfate has been successful in holding in check the black knot of the plum.

The San José scale may prove in more than one way a "blessing in disguise."

Potato Spraying Experiments.

A large field of potatoes on the college farm was used for experiments in spraying the past season. The field was located on the west slope near the farm barn, and included seven acres. The following varieties were planted: Early Harvest, Early Michigan, Carmen Number Three, Green Mountain and Delaware. These were planted in rows running lengthwise of the field. The experiment was carefully planned as regards varieties, conditions of the soil, etc., and running parallel to each of the various treated rows were left untreated ones for the purpose of comparison.

As there was some delay in obtaining the spraying mixtures, the whole field, including the checked plants, was sprayed once with Paris green for the potato beetle. In subsequent sprayings the following mixtures were used: wet Bordeaux containing Paris green, dry Bordeaux, copper phosphate and a mixture termed "1—2—3." The wet Bordeaux was made according to the standard formula (4—4—50). The other mixtures were proprietary substances, and were furnished by the Bowker Insecticide Company, which to our personal knowledge has always taken great pains to place on the market only the most reliable fungicides and insecticides. The "1—2—3" contained compounds of copper, arsenic and lime. The dates of the three applications were July 3, 7, and 12, no spraying being done after the latter date, on account of the luxuriant growth of the tops, which prevented access to the field without damage to the crop. The copper phosphate, dry Bordeaux and "1—2—3" are all dust sprays, and were applied early in the morning with a dust sprayer, when dew covered the foliage. The effects of spraying on this crop were carefully observed by various members of the station staff, together with Mr. Forristall, who supervised all the work, and made most careful observations as to the effects of the different sprays.

At the close of the experiments corresponding rows of the treated and untreated plants were dug, the potatoes carefully weighed by Mr. Forristall, and the results tabulated. The yields given by the various treatments are as follows: —

Average Yield of Sprayed Potatoes.

Treatment.	Average Yield (Pounds).
Wet Bordeaux,	55.98
Dry Bordeaux,	58.11
Copper phosphate,	52.34
"1—2—3,"	55.88
Untreated,	55.46

These results show no differences in the yield which can be ascribed to spraying. Observations on the condition of the crop during the summer did not show any material differences except in the case of the wet Bordeaux treatment, which was perceptibly superior in all respects to the others, at least during the greater part of the season. The plants treated with wet Bordeaux possessed the darkest-colored foliage, and were by far the most free from the flea beetle. The season was remarkably free from potato blights, the only thing occurring of any consequence being the flea beetle; and, with the exception of the wet Bordeaux, which contained Paris green, there appeared to be little or no difference between the treated rows and those untreated. At the time the potatoes were dug there was no perceptible difference to be observed between any of the rows. Owing to the season's comparative freedom from blight, little or no value can be placed upon these experiments.

The ease with which dust sprays can be applied makes the process of spraying less tedious, and a dust spray which possesses the merits of other reliable sprays on the market would be gladly received. However, careful tests of the relative merits of the wet and dry sprays indicate that the wet Bordeaux is superior in all cases to the dry.

Our potato growers should realize that the conditions in this State are entirely different from those in Vermont and Maine, and the spraying calendar recommended for those States is unsuited to our conditions, since their spraying is largely devoted to the control of the late blight, which is not generally severe here. On the other hand, it is the early blight, according to our experience, which does the most damage in Massachusetts; and in order to prevent attacks from this, farmers should commence to spray when the potatoes are not more than one-fourth grown, which would ordinarily be about the 20th of June. Much of the injury to potatoes is due to the flea beetle, which affects them in a manner similar to the early blight.

We believe that a first spraying of potatoes should be made with Bordeaux and "Disparene," instead of Paris green, since "Disparene" is a reliable insecticide, while Paris green is not, at the present time.

Copper Sulfate Treatment of Stagnant Water.

In a previous report we gave the results of a copper sulfate treatment of the college pond.[1] This pond is located on the college grounds, and contains about 8,000,000 gallons of water; it is quite shallow and has a muddy bottom. The amount of water which it receives during the summer months is not sufficient to cause a very constant overflow, and partly for this reason it occasionally becomes stagnant. There is also some pollution from cesspools which drain into it, and during freshets considerable amounts of fine sand, silt and clay are carried into the pond. Much of this silt, etc., remains in suspension for a long time, giving the water a yellowish tinge and roily appearance. Evaporation tests show that the water contains 45.6 parts sediment to 10,000 parts of water. During June the water usually has a disagreeable odor and becomes quite obnoxious. This odor is similar to that which rises from frog ponds where considerable decomposition takes place, and at other times it has the odor which is characterized as "fishy."

The pond has frequently been drained, which is responsible for stimulating growths of algæ, particularly Spirogyra, and for the past few years Anabæna has been present in greater or less amounts. It should be stated at the outset that our object in treating the pond was not to clear up points of controversy in connection with the copper sulfate method of treatment; it was done largely to obviate a nuisance.

That copper sulfate has an effect upon algæ has been known to physiologists for many years; but the treatment of large volumes of water with this chemical is, so far as we know, comparatively recent. Those who wish to become familiar with the more technical features of this subject are referred to the older literature, much of which is in German, and to the more recent publications of the United States Department of Agriculture and our own State Board of Health.

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[1] Eighteenth annual report, Hatch Experiment Station, 1906, pages 143–146.

The treatment given during 1906 was similar to that of 1905, and consisted in applying 1 part of copper sulfate to 4,000,000 of water. The copper sulfate was placed in a coarse bag attached to a canoe, which followed concentric circles over the pond until the copper sulfate was all dissolved. Samples of water were taken daily for bacterial examination a few days before treatment and each day after until July 19, when the experiment was discontinued. The usual bacterial methods were employed, with the following results: —

Table showing the Results of treating the College Pond with Copper Sulfate at the Rate of 1 Part of Copper Sulfate to 4,000,000 of Water. (Treated June 14, 1906.)

[Number of bacteria per c. c. of water.]

June 10,	7,005[1]	June 26,	846
11,	6,034[1]	27,	1,085
12,	5,757[1]	28,	1,231
13,	7,188[1]	29,	1,265
14,	7,158[1]	30,	1,006
14,	130[2]	July 1,	1,365
14,	56[3]	2,	1,231
15,	142[4]	3,	1,308
16,	156	4,	1,231
17,	156	5,	1,006
18,	341	7,	1,084
19,	554	9,	1,000
20,	769	11,	1,208
21,	1,000	13,	1,208
22,	1,000	15,	1,275
23,	756	17,	1,462
24,	768	19,	1,770
25,	927		

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[1] Before treatment.
[2] One hour after treatment.
[3] Two hours after treatment.
[4] Twenty-four hours after treatment.

The number of bacteria per cubic centimeter showed a decided falling off after the treatment, but subsequently an increase was noticed, although the number did not equal that present before treatment. The first bacterial examination of the water occurred one and two hours respectively after treatment, at which time there was noted considerable decrease in the number of organisms. It seems hardly creditable, however, that the copper could have been sufficiently diffused in the pond to cause such a rapid decrease in the number of the bacteria in so short a time. Some Anabæna were present in the pond previous to treatment, but none was observed directly afterwards; neither were any Spirogyra noted either before or after treatment. On the other hand, there were various forms of life, such as Daphnia, etc., present, both before and after treatment. No chemical analyses of the water were attempted, since the ordinary methods of analysis are not especially valuable in detecting slight traces of copper in water. It would appear from the culture of seedlings in glass vessels containing water and sand in which copper is present, and from the results of chemical analyses of the mud in the bottom of the reservoir, that a large amount of copper is taken up by this mud. The results of copper treatment of the pond in 1905 and 1906 show that the bacteria never regained their former numbers.

In a pond like this one, which is more or less polluted from cesspools, one would naturally infer that bacteria would increase rapidly after a few days. During August the pond was in an even worse condition than in June, as a large number of dead fish, termed "suckers," which had died from some unknown cause, were floating on the surface. Again during October there was a fairly luxuriant growth of Anabæna present for a few days, but this disappeared quickly, presumably on account of the rather cold nights which occurred at that time.

At the time the treatment was under way, parallel laboratory tests were made. For this purpose we employed 18 liters of water from the college pond in two rectangular jars, there being 9 liters in each jar, one of which was treated with copper sulfate at the rate of 1 part of the sulfate to 4,000,000 of water, while the other jar was left untreated. The jars were placed side by side in the laboratory, and exposed to the organisms of the air. The water was taken from the pond previous to its being treated. The results of the experiments are shown in the following table: —

Table showing the Results of treating Pond Water with Copper Sulfate at the Rate of 1 Part of Copper Sulfate to 4,000,000 of Water. (Experiment made in Laboratory, in Glass Aquaria Jars.)

[Number of bacteria per c. c. of water.]

DATE.	Pond Water untreated.	Pond Water treated.
June 14,	7,158	30[1]
15,	5,723	15
16,	4,849	38
17,	4,849	32
18,	4,444	24
19,	6,188	31
20,	7,927	43
21,	6,112	59
22,	4,772	101
23,	6,362	120
24,	5,313	54
25,	6,273	134
26,	7,004	126
27,	6,927	98
28,	8,282	170
29,	8,926	242
30,	6,419	310
July 1,	7,004	270
2,	7,409	298
3,	8,107	340
4,	6,792	930
5,	7,972	872
7,	10,168	800
9,	6,412	1,060
11,	6,989	1,000
13,	7,399	940
15,	6,034	946
17,	8,632	1,390
19,	10,656	1,240

[1] One hour after treatment.

The results shown in this experiment coincide in a general way with those of the previous one. They are, however, of more value, since they show the bacterial flora of the normal or untreated pond water.

It will be noted that the number of bacteria in the untreated pond water remained quite constant throughout the experiment, while the water treated with copper sulfate showed the same general decrease in the number of bacteria. The subsequent increase in the number of bacteria in the treated water in the laboratory experiment was smaller than that shown by the pond experiment. Furthermore, a comparison of the two jars in the laboratory experiments showed that the water in the treated jar was much clearer, owing to the fact that most of the forms of living matter had been killed and had settled to the bottom of the jar. This was proved by the much larger amount of sediment in the bottom of the treated jar than in the untreated.

Large bodies of water can be successfully treated with copper sulfate, and many undesirable forms of organisms eliminated. The copper sulfate treatment, moreover, appears to exert an influence upon the bacterial flora for quite a length of time; but after a certain period has elapsed a body of water may become as badly contaminated with various forms of living matter as before, or even worse.

The location of the college pond is such that no harm could result in any way from a treatment with copper sulfate, even though some of the copper escaped. Precautions, however, must be exercised in treating bodies of water; and the safest method to follow, in case such treatment is necessary, would be to consult our State Board of Health or others familiar with this subject.

Banding Substances for Trees.

In connection with the renewed warfare against the gypsy and brown-tail moths, a number of new banding substances, which are claimed to be effectual as insect barriers and harmless to trees, have been placed on the market within a year or so. These substances are sold under various names and at varying prices, and they are quite dissimilar in their chemical composition and in the effects produced on trees. Any substance which is likely to cause even the slightest injury when applied to trees should not be employed, and when such substances actually cause the death of trees, it becomes a gross offence to apply them to public shade trees.

At the request of William B. de las Casas, Esq., chairman of the Metropolitan Park Commission, the writer made an examination during the summer of 1905 of a large number of trees located in Middlesex Fells and other districts around Boston, with a view to determining the effects of the various so-called banding substances on trees.

In addition to our numerous examinations of the effects of these various substances on trees, we have tested a great many in a critical way on small plants. Our conclusions relating to the effects of the substances are based upon a larger number of observations, together with numerous tests on stems, leaves, etc., of a variety of herbaceous plants. Any substance which causes injury to herbaceous plants may also produce the same effect on trees, although the time necessary to produce injury to herbaceous plants is brief compared to that necessary to give rise to corresponding results in a tree.

A good banding substance should not cause the slightest injury to trees, or even to tender tissues. It should not harden at low temperature, neither should it melt at comparatively high temperature. It should be inconspicuous when applied to the tree, and easily put on and removed, and should remain sticky during the entire season.

Tanglefoot. — This material is now extensively used, and is a semi-transparent, sticky substance, not affected by low temperature (32° F.) or by temperatures under 125° or 130° F. Its principal bases are probably castor oil, resin and wax, which are substances harmless to vegetable tissue; and, whatever the other constituents of this banding substance may be, they do not render it harmful to trees. Tanglefoot applied to a large number of plants possessing a thin epidermis has never caused any injury. In short, this is the only substance which we have met which stands all the tests a perfectly harmless banding material should when applied directly to plant tissue.

Bodlime. — This is the proprietary name of a substance resembling Raupenleim, a European product, and both have been on the market for some years. Bodlime is an American preparation, and has been used extensively for some time. The directions which are furnished with Bodlime advise first putting a band of tarred or sheathing paper eight inches wide on young or thin-bark trees, and then applying Bodlime to the band. Over 90 per cent., however, of the trees examined by us last summer on which Bodlime had been applied were those of the smooth-bark type, ranging from two inches to two feet in diameter, and in no instances were tarred or sheathing paper bands applied. In practically all cases this substance had penetrated the bark and injured the cambium layer. This injury, however, is in all probability not sufficient to kill the trees in every case; but more or less prominent effects will be left on the trees for some years, as evidence of the injury due to Bodlime. Some specimens of trees six inches in diameter were pointed out which were killed with Bodlime; and practically all the Carolina poplars located on the Fellsway, Malden, which have been treated with this substance, showed much injury to the cambium layer, resulting in prominent swellings on the trees where this substance had been applied.

A number of small white maples (two or three inches in diameter), which had been treated with Bodlime, appeared in two or three weeks to have an abnormal cambium layer, due to the penetration of the substance to the vital tissue. In all these cases Bodlime was applied directly to the trees, without paper bands. It should be noted, however, *that the manufacturers never intended that it should be applied to small or smooth-bark trees without first banding with tarred or sheathing paper, and the directions specifically state this.* When this is applied to large trees, however, without paper banding, it generally causes some subsequent slight disfiguration of the tree. We believe, however, that Bodlime constitutes a reliable banding substance, and can be applied to trees if the directions of the manufacturers are followed, — to first put on a band of tarred or sheathing paper. It should by no means be considered a reflection on the manufacturers if people will persist in ignoring the proper directions for applying the substance, as there is scarcely a remedy on the market which will not produce injurious effects if used injudiciously.

Anti-Moth. — This substance was used considerably in the summer of 1905 as a tree-banding material. It is a dark-colored, pasty substance, suggestive of wheel grease, and is applied directly to the bark. There were many instances observed where it was causing injury by soaking through the large, thick, rough-bark trees, as well as small, thin-bark ones. The trees which came under our notice had been treated only a few weeks with this substance, but our observations were sufficient to show that this constitutes a dangerous substance to apply directly to the bark of trees. Various small herbaceous plants banded with Anti-Moth died in a few days.

Eureka Tree Paste. — This substance as a banding material is not so universally employed as those previously mentioned, therefore our observations were limited in regard to its effects on trees. Moreover, this material, at the time our observations were made, had been on trees for only a brief period of time, consequently, the ultimate effects on the trees have not been observed by us. This substance resembles Anti-Moth, and is applied in the same manner. From the nature of the material, and its effects upon the stems of herbaceous plants, it cannot be recommended as a safe banding substance. Our experiments on herbaceous plants show that it is equally as injurious as the substance previously mentioned.

Raupenleim and Dendrolene. — These have been used as banding materials, although we have seen no authentic instances where they have been applied to trees in the vicinity of Boston during the past year. Raupenleim is a well-known German banding material, and Bodlime is supposed to be in many respects similar to it. Both, as far as we can learn, have about the same effects on vegetable tissue; that is, they injure it. Raupenleim was previously used by the Gypsy Moth Commission in large quantities. Dendrolene is an American product, apparently similar to Raupenleim in every way, both being crude petroleum products.

Razzle Dazzle. — During the past year our attention has been called to the use of a banding substance termed Razzle Dazzle, which has been employed to some extent on trees. This substance was sent in to us from one of the towns in the vicinity of Boston, with the report that it was doing damage to trees. We made a test of the substance on various herbaceous plants, and found that it killed them in a very short time. The substance appears to be made of resin, castor oil and some other oil-like petroleum which is injurious to vegetable tissue. We found that Razzle Dazzle has altogether too low a melting point. It commenced to run at about 90° F., and flowed freely at 100° F.

Bug Stop. — This substance is apparently made out of resin, oil and some form of grease, which causes injury to vegetable tissue. We found on testing this that it was very similar in its effects on tissue to Razzle Dazzle, and has a melting point ranging from 79° to 94° F. Besides the injurious effects which it has on vegetable tissue, it has a melting point entirely too low to make it a desirable banding substance.

Printer's Ink and Tarred Paper. — Printer's ink applied to tarred paper has been used to some extent for many years as a banding substance, and no ill results arising from its use have met our observation. We find this substance used extensively in the city of Medford on General Lawrence's estate.

Other Injurious Substances. — In one of the cities in the neighborhood of Boston crude petroleum or gas oil, such as is used in the manufacture of water gas, has been extensively used in spraying the trunks of trees for the purpose of killing gypsy moth eggs. This substance penetrates the bark very readily, and kills the vital layer. There are numerous instances where trees have been completely girdled, and have died in a very short time from the use of this substance.

Gas oil and creosote are used extensively for treating gypsy moth nests, and when mixed with lampblack they appear to cause little or no injury. Both of these substances are capable of causing injury to plants, either when used alone or when mixed with lampblack. We have not discovered any injury to trees from the use of these substances, however, when mixed with lampblack and used as a paint for the treatment of gypsy moth egg clusters. In one instance, where creosote and naphtha were applied with an atomizer to the trunks of trees covered with gypsy caterpillars, at the rate of 1 part of creosote and 5 parts of naphtha, the bark was rendered brittle and lifeless. At the time our examinations were made on these trees no injury had occurred to the cambium layer, but we should suspect that injury would later follow this method of treatment.

Some injury to trees often occurs from the use of kerosene, or kerosene and water together, when applied to the bark of trees. Kerosene and water have occasionally been applied to tree trunks for various insect pests by the aid of a certain mechanical mixing device. It should be stated, however, that these mechanical mixers are unreliable, and it is never safe to apply kerosene to trees, not even when mixed with water. The use of a gasoline blower or torch for the purpose of killing caterpillars has been in vogue to some extent. This should be condemned, since some injury has resulted from this practice. Scraping the bark too closely previous to applying a banding substance should be guarded against.

In conclusion, it may be said that Tanglefoot appears to be the only banding substance which we have tested that does not in any way cause injury to plant tissue, and that can be safely applied directly to tree trunks. Since this substance has a tendency to run at about 125° to 130° F., a slightly higher melting point would improve it. The manufacturers test this substance at 126° F., on a smooth, vertical surface, claiming that it will not run below that temperature; also, that some of their samples will not run below 130° F. They state that it will stand a little higher temperature on the bark of trees before it begins to run. Unfortunately, much of the Tanglefoot sent out by the manufacturers last spring was made on a different formula, and the melting point was entirely too low. It was sent back to the manufacturers, and modified according to a previous formula.

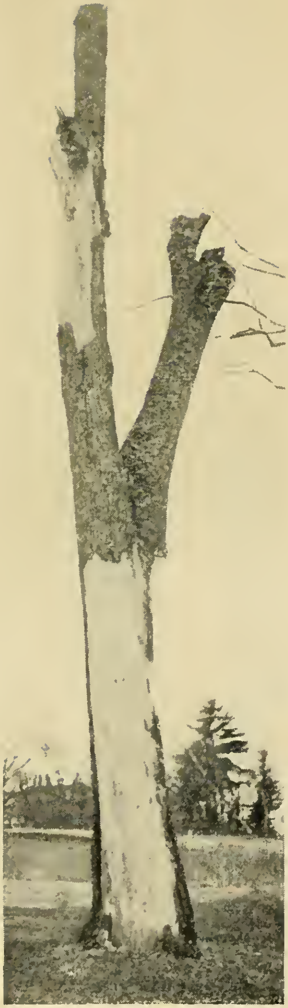
Such material as printer's ink, Bodlime, etc., can be safely applied to tree trunks in connection with tarred paper; and the latter can also be applied to rough, thick-bark trees without killing them, although even when used in this manner it will often produce some injury, which, however, may not prove fatal. We believe that it is essential, in applying any substance to a tree as a means of protecting it against insects, that one should be well within the limit of safety.

In this connection it should be noted that all of the manufacturers of these substances are, so far as we have learned, honorable business men, as is shown by their perfect frankness, and desire not to place any substance on the market which is not reliable. However, one should be cautious in purchasing newly advertised banding materials, since we have reason to believe that some of these new mixtures will not prove reliable. We have had opportunities to test a large number of new mixtures during the past two years, none of which, in our estimation, answers the requirements of a good, reliable banding substance.

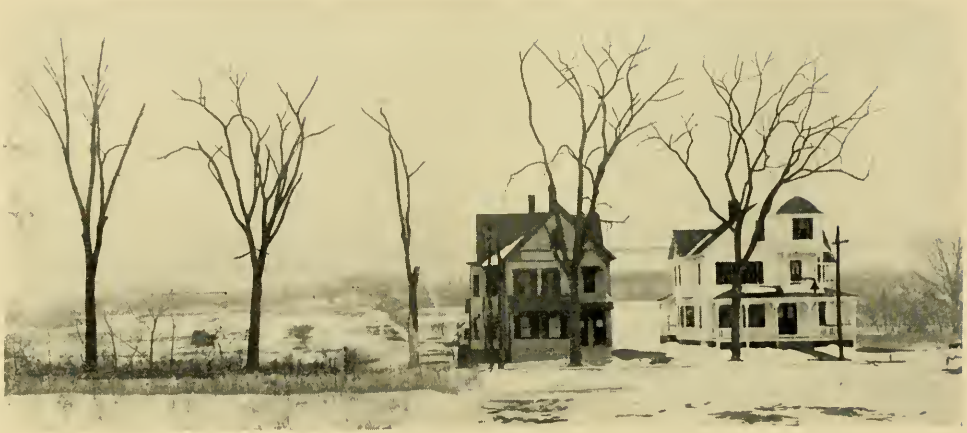
Effects of Escaping Illuminating Gas on Trees.

Undoubtedly a larger number of trees suffer from the effects of escaping illuminating gas at the present time than in previous years. The increased death rate from this cause may be accounted for by the fact that gas is now more extensively used than formerly, and the larger pipes now in use, together with modifications in the methods of laying these pipes and calking, may be in part responsible for the increased leakage. At any rate, it would seem that where small pipes have been in the ground for many years with thread joint connections there is much less leakage than where larger pipes are used, and where the calking is done with Portland or Roman cement and oakum or lead.

There is a large amount of gas manufactured by companies which is unaccounted for. According to the twenty-first annual report of the Gas and Electric Light Commissioners of Massachusetts, the production of gas for the year 1905 in this State was 6,418,024,954 cubic feet. The amount unaccounted for during that year was 622,304,044 cubic feet; in other words, there was a loss of about 10 per cent. Probably this loss represents more than mere leakage, since part of it may be accounted for by differences in temperature which the gases are subjected to when measured. Nevertheless, there



Showing effect of illuminating gas on elm tree, one and one-half years after leakage occurred. (From "Park and Cemetery.")



Large elms killed by escaping illuminating gas, one and one-half years after leakage occurred. (From "Park and Cemetery.")

is a very large number of leaks in gas mains at the present time, and the number of cubic feet of gas which annually escape into the soil is quite large.

There are a great many joints in gas mains from which can be detected only slight leakage, — perhaps from two to three cubic feet a day; whereas there are others from which the leakage is very extensive, and from which thousands of cubic feet of gas escape into the soil in the course of a year. Even these smaller leaks, where the outflow is only from two to three cubic feet a day, are capable of injuring trees in the course of time, since the soil becomes charged with gas to quite an extent in a few years. Should the roots of trees happen to be near these leaks, the trees will become unhealthy, but perhaps will not die. There are hundreds of city trees affected in this manner, and gas is seldom suspected of causing their sickly condition. In the eastern States, at least, there are three kinds of gas used, — water gas, coal gas and oil gas. So far as the effects of these various gases on trees are concerned, there is apparently little or no difference, since they all contain similar elements which are poisonous to trees.

There are two classes of injury which may readily be distinguished as resulting from gas poisoning: first, incipient cases; and second, pronounced cases. In the first series we have those already alluded to as resulting from small leaks, and the ground in such cases never becomes fully charged for any considerable distance. They may not result in killing the tree directly, but cause it to be unhealthy, and there is likely to be a large amount of dead wood found on such trees annually. Occasionally a large tree may be located near a small leakage, and in such a case only a single root will be affected. Those portions of the trunk of the tree in direct connection with the leak will, however, show the effects of gas poisoning. Small leaks of this description often produce only local injury. Trees affected in this manner may suffer with what is termed "general debility," — a term often used to cover up a vast amount of ignorance concerning diseases in general. In severe cases of gas poisoning, such as take place where there is a large leak, the effects on a tree are very pronounced, and there is absolutely no hope of recovery for a tree which has once been severely injured by gas; in short, where a tree has been defoliated or even half defoliated from the effects of gas, there is no hope for it, although it might be possible, if one could dig up all the soil around it and expose it to the air, to eliminate much of the gas in the soil, in which case the tree might make some attempt to recover.

The characteristic symptoms of gas poisoning are quite marked to one familiar with them, and can generally be distinguished from other kinds of injury which are likely to affect a tree. It requires, however, pretty close observation and thorough understanding of conditions in order to distinguish gas poisoning from some other types of injury which may occur. For example, in the gypsy moth district about Boston the trunks of many trees have been treated with crude oil and various other substances which are exceedingly injurious to trees. Crude oil or kerosene, when sprayed on the bark of a tree, will penetrate the wood to some extent. Unless one is perfectly familiar with the characteristic symptoms of trees poisoned with gas, it would be a very easy matter to confound these two classes of injuries. In both cases the bark becomes loose and falls off the tree very quickly. From careful observations of the trunks of trees, however, the effects of crude oil can generally be distinguished from those caused by gas, by one who is familiar with these characteristic injuries.

In general, however, the symptoms shown by trees affected with illuminating gas are quite different from those arising from other causes which are likely to be active. Trees affected with gas are very susceptible to rapid disintegration. One of the first effects of poisoning in summer would be a yellowing and drying up of the foliage, and a greater or less defoliation of the tree, according to the degree of poisoning. The trunk of the tree is generally dark colored, indicating an absence of life; but this feature is not always present.

The occurrence of various species of fungi on trees affected by gas is rather conspicuous, since these fungi are often very numerous, and make their appearance soon after a tree has been injured; whereas on trees dying from other causes it is sometimes many years before the bark becomes covered with fungi. The sap wood is often found to be discolored, and it has peculiar, characteristic odors which assist in a diagnosis. Sometimes, however, especially when the tree is injured by gas in late summer, at which time the flow of sap is not so pronounced as in the spring, the odors of the wood are not so marked.

The writer has had many years' experience in examining trees injured by illuminating gas, and has had occasion to study a large number of them each year. In our diagnosis of such trees we make use of a small hatchet, which is employed to cut into the trunk of a tree for the purpose of examining the tissue. In most cases it is only necessary to insert the hatchet into the trunk and gradually pull the tissue back to see whether it is normal or abnormal. Little injury is done to the tree by this practice, as a mere slit in a healthy tree will heal over in a short time. In other cases it is necessary to take out a chip and examine the tissues under a microscope. An examination, by means of a hatchet, of the larger roots which extend above the surface of the soil, causes less disfigurement, and the source of leakage, if such is present, may be discovered. The escape of gas into the soil from a leak follows the line of least resistance. For this reason, if leakage occurs in the street in front of a house one can usually detect the odor of gas in the cellar, as the gas will follow the exterior of the pipe leading into the cellar.

There is considerable difference in the resistance of soils to gas. In gravelly soils we have known gas to travel 2,000 feet without any difficulty when the ground is frozen, and escape into the cellar of a house; whereas in heavier soils gas is more likely to be restricted to smaller areas.

The poisonous properties of gas undoubtedly consist in the coal tar products, which contain such compounds as sulfates, cyanides, etc. Gas escaping into the soil probably condenses fully as rapidly as in the pipe. The gas-drip which is taken out of a pipe is the condensed portion, and this in itself is very rank in odor and extremely injurious to plants, whether the volatile products are taken in through the leaves or the liquid through the roots. It is apparently these condensed products which are taken up by the roots and which poison the tree. About 1 or 2 per cent. of gas is absorbed by water, and the water in the soil becomes charged to a certain extent with gas. In the course of time, where the leakage is more or less extensive, the odor of the soil becomes extremely obnoxious. This odor disappears very quickly when the soil is aerated; in fact, when a gas leak is found it is an excellent idea to leave the ditch open for a few days, to get rid of the strong odors which are present in the soil. There is a certain capacity of adaptation of plants to poisons, and this probably exists to some extent in the case of trees; but this capacity is limited, and where the leakage of gas is continuous, the roots are sure to be poisoned in time. The writer has treated various small trees and plants with gas, and has grown plants in water charged with it. Gas, like many other poisons, acts as a stimulus to plants at first, but eventually kills them. It is possible, however, to keep roots alive in water charged with gas every twenty-four hours for a considerable length of time. Finally, however, after the plant has absorbed a certain amount the cambium layer is affected, and disintegration takes place rapidly. It requires a considerable amount of gas to kill a large tree, but it must be borne in mind that the conditions surrounding a tree are favorable for maintaining gas in the soil for a long time. Mr. H. A. Ballou, one of our former students, treated a large maple tree with 1,000 cubic feet of gas. This was done by digging a hole in the ground under the feeding roots to a depth of four feet or more, and the gas was allowed to escape into the soil at this point for a number of months. The result was that not the slightest injury was done to the tree. If, however, the same amount of gas had been allowed to escape near a tree located on a macadamized road, and the leakage had extended over a period of two years instead of three or four months, some injury would have been discernible.

Many gas companies now openly recognize the fact that a certain amount of gas leakage occurs continually, and that a certain number of trees are likely to be killed each year; therefore, they endeavor to settle all claims for damages to trees arising from gas out of the courts. In Massachusetts the court has decided in more than one instance that a good-sized, well-developed and sound tree in front of an estate is worth from $150 or $200 in the valuation of that property; and if such a tree is killed by gas, the abutter is entitled to damages. In most of the cases of gas poisoning the companies have settled with the abutters, allowing anywhere from $5 to $150 a tree. In other States courts have decided that an owner of land which abuts on a city street and which is planted with shade trees is entitled to have such trees protected against negligence or wilful destruction at the hands of a third party. A large, handsome tree taken from a well-kept avenue is a greater loss to the abutter's property than a similar tree on a poor, ill-kept street. Moreover, a tree half-killed by the teeth of horses is not worth as much as one in good condition. In some cities gas companies have settled with the city for the loss of trees.

According to tree laws in Massachusetts, gas companies are undoubtedly subject to a fine for injuring or causing the death of a tree, in addition to the damages for causing a deterioration of property owing to the loss of such trees, since the laws relating to injuries to shade trees are explicit. In some cases the abutter is satisfied if new trees are planted to replace the old ones.

Undoubtedly much of the loss arising from gas the past few years has been due to inferior work in laying pipes. In one small city, where four miles of pipe were laid, we were able to find one hundred trees which were injured beyond recovery from gas poisoning, two years after the gas mains were laid; and we venture to say that three or four hundred other trees in the same locality were more or less affected by gas, many of which will subsequently die a premature death.

Germination and Growth in Soils of Different Texture.

It requires only a casual glance at the flora of any region to note the fact that soil texture plays an important part in the distribution and adaptation of plants. Soil, however, is so intimately connected with and modified by other factors, such as organic matter, arrangement of the particles of the soil, chemical constituents, the presence of living organisms and differences in the amount of water, that it is a most difficult problem to determine accurately the role which texture alone plays in plant distribution and adaptation.

Humus is undoubtedly closely associated with certain ecological features connected with the life history of plants, since it furnishes an environment for various micro-organisms which in some instances amount to many millions per gram; and if the behavior of these organisms in culture media furnishes a criterion for their activity in soil, important chemical changes must take place.

In endeavoring to account for the distribution of any particular species of plant, one is confronted with a complex problem, since there are various influences responsible for distribution, and the elimination of these factors is beset with difficulties.

In some cases differences in the degree of adaptability of plants appear to exist corresponding with their stages of development; for example, a seedling will die in a soil of certain texture, when a more mature plant of the same species will succeed in thriving to a greater or less extent.

Soil texture exerts an influence upon the configuration of plants which may be seen even in restricted areas; for example, certain soils are especially adapted to the luxuriant development of elms, and such soils exert a marked influence not only upon the general type of tree, but the color, size and texture of the leaves, — a feature which may be seen to a similar degree in other native plants.

Among our well-known cultivated plants there are some which are influenced to quite an extent by soil texture, the best known among these being tobacco. Since the texture, aroma and color of the leaf is tested many thousand times daily by smokers, much knowledge has been gained regarding the influence of soil texture and other factors upon the growth of this crop. It is well known that the crops from some soils sell for two and three times as much as those grown on soils of a different texture. In the development of head lettuce soil texture also plays an important role. This type of lettuce is largely grown on the Atlantic coast soils, which predominate in the coarser grades of sand. When head lettuce is grown in finer-texture soils it does not head up well, and little or no attempt is made to grow this crop in soils of this nature. Lettuce seed sown in a soil of fine texture will not germinate nearly as well as in loose soil, and lettuce seedlings will reach a certain stage of development, remain stationary for weeks and eventually die. The reason why a fine-texture soil prevents seedlings from developing is lack of air. This may be illustrated by the more vigorous growth which lettuce seedlings make in such a soil near the edge of a flower pot than in the middle, and by various soil aeration experiments.

The compactness of a soil, as might be expected, exerts an influence upon germination and growth. The following table shows the effect of loose and tamped loam and subsoil upon the germination of seeds. In one case a good loam, containing about 8 per cent. of organic matter, was employed, one box being tamped very firmly with a heavy weight after the seeds were sown, and the other left very loose. In the other case two boxes of soil of fine texture (subsoil) were employed. This soil was very deficient in organic matter. These two boxes were treated in a similar way to those containing loam; that is, one was left very loose and the other tamped firmly after the seeds were sown. In all the boxes very little soil was placed over the seed.

Result of Seed Germination in Loose and Tamped Soils.

	Loam.		Subsoil.	
	Loose.	Tamped.	Loose.	Tamped.
Lettuce, 200 seeds,	75	–	51	–
Rattlebox, 200 seeds,	80	22	33	7[1]
White clover, 400 seeds,	146	7	45	–

[1] The seedlings came up in cracks in the soil.

No lettuce seed germinated in the tamped loam or subsoil, while white clover made its appearance in the tamped loam. Rattlebox, which with us is quite at home in fine-texture soil lacking organic matter, did better than the lettuce or white clover. None of the seed possessed a high percentage of germination, and some allowance must be made for this. All of the seed germinated better in the loose loam than in the loose subsoil, and the rattlebox and white clover showed greater capacity for adaptability to tamped soil than the lettuce.

Lettuce is remarkably susceptible to lack of soil aeration, as is shown by the many experiments we have made with this plant. The following table shows the effect of soil texture upon the germination and growth of lettuce. The boxes employed in this experiment were eight inches square, and each was nearly filled with carefully sifted coal ashes, containing particles corresponding to the sizes given in the table. Each box was weighed and watered daily, and the amount of water applied was such that the degree of saturation was equal to one-half the water-retaining capacity.

Influence of Soil Texture on the Germination of Lettuce Seeds and Growth of Seedlings.

	Size of Particles (Millimeters).	Per Cent. of Germination.	Average Weight of Seedlings (Milligrams).
Box 1, ...	2–1	54.2	40–60
Box 2, ...	1–.5	38.0	80–84
Box 3, ...	.5–.25	24.8	59.99
Box 4, ...	.25–.1	33.0	41.45
Box 5, ...	.1–.0001	14.2	19.25

The preceding table includes the results of three experiments, in which 3,000 seeds were employed. The highest percentage of germination is given by the seeds sown in ashes containing particles having a size of 2–1 millimeters; while the largest average weight of the seedlings is shown by those which were grown in ashes containing particles having a diameter of 1–.5 millimeters. In the case of some experiments in similar boxes with sand the highest percentage of germination took place in the particles ranging from .5 to .25 millimeters; and the largest average weight of seedlings was given by the particles ranging in size from 1 to .5 millimeters, or the same as in the experiment with ashes. It should be pointed out that important differences exist between coal ashes and sand in respect to absorption of moisture. This was quite noticeable in the experiments, inasmuch as the ashes act like a sponge and water is retained to quite an extent by them; while in the sand no such absorption takes place, as is readily shown by the top layers of the coarse sand becoming dry, — so much so at times that seed germination was seriously interrupted. For this reason it was impossible to maintain the same relative degree of moisture in the various strata in the sand boxes as in the ashes. Since ashes were more porous and spongy, the difference in the amount of moisture in the various strata was less marked, and there was no difficulty in maintaining enough moisture for germination in the coarse particles of coal ashes.

The influence of variation in the soil moisture cannot be eliminated in comparative experiments with soils of different texture, since the capillarity of the different grades of soils is by no means the same; neither is the amount of water which the seeds and seedlings received under these conditions identical.

Some parallel experiments were undertaken in shallow plates, containing about three-fourths inches of coal ashes, having the same range in the size of particles as in the previous experiment, with somewhat similar results. In the plate experiments the difference in the amount of moisture due to the difference in the capillarity was considerably modified, since the substratum was so shallow that the seedlings, after they had become mature to a certain degree, could obtain practically the same amount of water from each type of particles, providing evaporation was checked, thus preventing stimulation which would arise from the difference in the water supply, although the water in the plates containing the coarse particles would be more largely confined to the lower strata. Soil texture and water supply are intimately associated, and this has led some to believe that water constitutes the ruling element in the soil in crop production. Respiration is also an important function in plants, for which process oxygen is necessary. When plants are deprived of oxygen they cease to grow, and seeds will not germinate.

It is important that roots be supplied with air for respiration, as is shown by aeration experiments; and in the experiments with lettuce the difference in the percentage of germination and growth of seedlings in ashes was determined by differences in the air supply furnished by the various grades of particles employed.

Texture of Massachusetts Soils.

For some years this department has made mechanical analyses of soils in connection with the study of problems relating to greenhouse crops, and for various persons who desire to know the constituents of some particular soil. A list including some of the analyses is presented with this report, the soils being grouped in a general way under different headings.

In the list of soils which follows, acknowledgment should be made to those who have taken part in this work, most of whom have been from time to time students and assistants in our laboratory. Some of these soils were analyzed by Mr. Asa S. Kinney, now director of the Botanical Gardens at Mount Holyoke College; others by Messrs. A. A. Harmon, A. C. Monahan, A. L. Dacy, E. H. Scott, L. K. Liang; and particularly Mr. N. F. Monahan, assistant in the laboratory, who has made by far the greatest number of these analyses.

The methods employed are those recommended by Dr. Milton Whitney. In some of the earlier samples the finer-grade material was separated by the gravity method, while all the later analyses have been made by the centrifugal method of separation. In all cases 20 grams of soil were used in each analysis.

The soils best adapted to general market gardening are those which contain considerable proportions of coarse material, which render them loose and friable. Such soils predominate near the coast, and excellent types may be found in many of our river valleys. The soils about Boston, especially those in Arlington, Belmont, Newton, Bedford and Concord, are exceptionally well adapted to market-gardening purposes, and some of the best crops in the United States are raised in these towns. Market gardening has been carried on in the above-named localities for many years, and remarkable skill has been developed in handling certain crops. This statement holds true not only in general truck farming, which is followed to a large extent in these regions, but is especially applicable to the cultivation of head lettuce under glass, in which unique skill has been developed.

It is not unusual for market gardeners to put 40 cords of horse manure per acre on the land used for market-gardening purposes, and to a soil devoted to greenhouse lettuce even larger quantities of manure are applied. In general, the best market-gardening soils are those which contain a large amount of coarse material, which is well illustrated by the Belmont, Newton, Concord and Bedford soils. (*Cf.* Table I.)

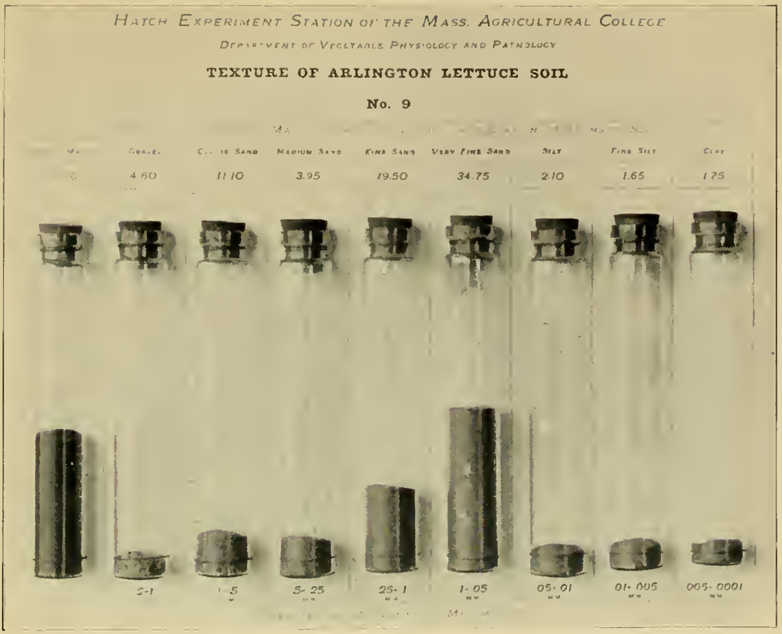
In a similar class may be included Worcester soil No. 10, New Bedford, Swansea and Touisset. The Worcester soil No. 10 is from a river valley, and is well adapted to the growth of head lettuce. The Providence soil is quite similar to those of Cape Cod, and is somewhat coarser than the Arlington and Belmont types. When these coarser soils are well supplied with organic matter they are suitable for lettuce. The Worcester soils Nos. 13 and 20, together with the Amherst, Huntington and Pittsfield soils, are not desirable ones for head lettuce, since they are too compact. These soils, however, have been used for lettuce, and for this reason are included in this list.

TABLE I. — *The Mechanical Analyses of Some Market-garden Soils.*

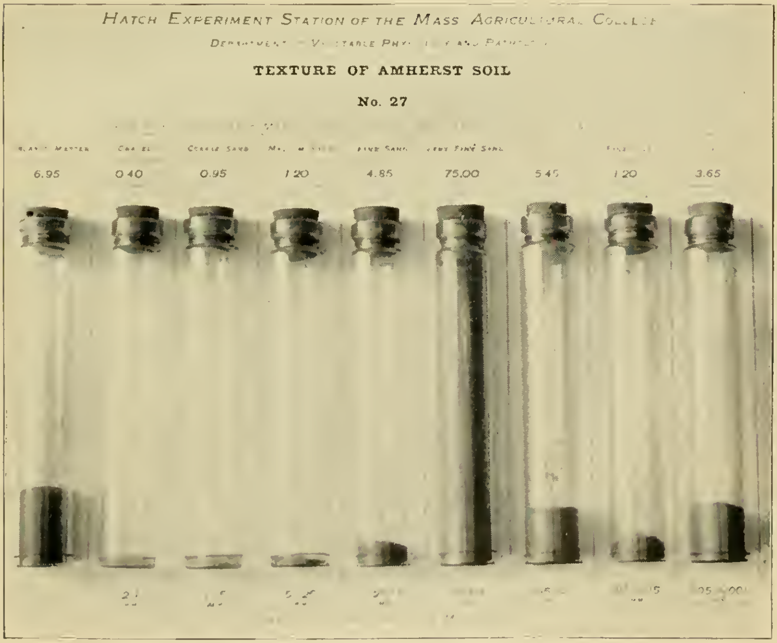
[Diameter of the grains in millimeters (1 millimeter equals about 1/25 of an inch); gravel, 2–1; coarse sand, 1–.5; medium sand, .5–.25; fine sand, .25–.1; very fine sand, .1–.05; silt, .05–.01; fine silt, .01–.005; clay, .005–.0001.]

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
6	Pittsfield, . . .	50.00	11.50	5.35	5.00	4.80	14.00	37.00	7.05	1.20	6.95
9	Belmont, . . .	51.30	10.00	4.60	11.10	3.95	19.50	34.75	2.10	1.65	1.75
14	Subsoil of No. 9, .	29.30	1.80	2.85	8.25	14.30	32.20	32.05	2.30	1.30	2.35
10	Worcester, . . .	46.20	9.01	7.17	15.40	10.10	15.30	29.54	9.85	2.87	2.07
13	Worcester subsoil, .	41.00	9.60	1.40	2.00	3.95	20.70	43.45	7.20	3.05	3.60
15	Newton, . . .	67.90	15.18	5.75	8.12	7.07	12.06	34.01	2.10	0.20	3.82
16	Spencer, . . .	50.00	9.80	2.70	4.55	7.30	22.35	29.60	6.65	2.45	3.25
17	Providence, R. I., .	39.60	6.65	9.20	17.85	16.85	20.90	22.50	2.75	0.40	2.25
18	Pittsfield, . . .	61.00	11.00	5.65	6.90	5.25	13.75	35.30	5.95	0.55	3.85
19	New Bedford, . .	40.00	7.60	4.10	5.45	6.45	12.00	39.45	6.95	5.50	5.55
20	Worcester, . .	45.10	9.40	1.65	2.80	4.25	19.85	42.95	4.50	2.95	2.75
21	Worcester subsoil, .	36.50	2.80	1.00	1.20	1.10	8.30	66.45	7.35	2.10	5.35
22	Amherst, . . .	40.50	6.00	2.60	5.90	7.90	15.40	40.75	9.25	2.60	4.65
44	Huntington, . .	43.20	8.00	0.36	0.90	1.32	10.09	29.40	27.38	6.35	7.93
47	Concord, . . .	46.59	7.80	5.45	11.01	13.95	25.03	17.87	12.38	0.99	2.75
52	South Sudbury, .	59.93	9.40	2.59	5.79	7.93	25.19	26.38	12.74	2.45	0.98
57	Bedford, . . .	67.21	12.64	3.80	5.30	5.40	15.02	22.91	19.63	7.34	3.37
65	Waltham subsoil, .	54.01	4.32	0.83	1.58	1.94	10.82	44.81	21.15	4.49	7.25
77	Belmont, . . .	42.66	13.20	3.18	5.85	12.13	37.34	14.12	3.60	0.59	1.73
89	Swansea, . . .	61.80	10.44	4.80	5.07	13.19	21.72	22.88	14.60	1.36	3.49
95	Touisset, . . .	51.30	11.66	2.37	3.59	13.63	19.44	32.39	13.22	0.79	1.64
97	Belmont, . . .	50.00	10.57	6.49	5.84	10.49	11.65	30.25	9.33	4.78	4.01

The greenhouse cucumber soils given in Table II. are from widely separated localities, and, with the exception of the organic matter which they contain, are no better adapted to the growth of cucumbers than soils which may be selected from other places. One special feature, however, in connection with these soils is the large amount of organic matter which they contain, which greatly modifies their texture. Most greenhouse soils are rich in organic matter, which is furnished by the extensive use of horse manure and de-


Hatch Experiment Station of the Mass. Agricultural College
Department of Vegetable Physiology and Pathology
TEXTURE OF ARLINGTON LETTUCE SOIL
No. 9
Gravel
Medium Sand
Fine Sand
Very Fine Sand
Silt
Fine Silt
Clay
4.60
11.10
3.95
19.50
34.75
2.10
1.65
1.75
2-1
1-.5
.5-.25
.25-.1
.1-.05
.05-.01
.01-.005
.005-.0001

An ideal market-garden soil.


Hatch Experiment Station of the Mass. Agricultural College
TEXTURE OF AMHERST SOIL
No. 27
Coarse Sand
Fine Sand
Very Fine Sand
6.95
0.40
0.95
1.20
4.85
75.00
5.45
1.20
3.65

Not well adapted to market gardening.

composed sod. Cucumbers are not so susceptible to soil texture as lettuce, since almost any soil fairly well provided with organic matter is suitable for their growth; while in the cultivation of head lettuce it is necessary to have, in addition to a good supply of organic matter, a certain percentage of the coarser particles of soil.

The best method of preparing soil for cucumbers consists in mixing one-third horse manure, one-third loam and one-third sod. These constituents form a suitable basis for a good cucumber soil, and by the extensive use of horse manure each year it can be kept in good condition.

TABLE II. — *The Mechanical Analyses of Some Cucumber Soils.*

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
34	East Brookfield, .	50.66	6.00	7.80	21.18	18.57	17.01	21.96	2.89	2.18	2.25
74	Athol, ...	57.30	22.46	8.71	12.80	7.33	12.39	8.85	13.21	2.59	1.39
75	Lincoln, . . .	57.00	11.00	2.36	6.18	7.87	24.66	29.89	13.33	0.83	3.14
76	Fitchburg, . . .	42.70	26.02	2.71	7.91	6.45	13.05	12.64	18.33	3.36	1.33
94	Beverly, . . .	66.40	12.13	6.21	6.94	12.26	10.97	29.48	15.32	1.55	1.39

Asparagus is usually grown on a coarse, sandy soil, generally deficient in organic matter, partly for the reason that such soils will not grow anything else satisfactorily. It by no means follows, however, that asparagus requires this type of soil, since, as a matter of fact, the best beds in the State are located on soil of finer texture than most of those shown in Table III.

Such soils as Nos. 33 and 73 possess finer textures than others, and they are excellent asparagus soils, besides having the advantage of growing crops which are not subject to the summer stage of the rust; whereas plants grown in coarse soils are often severely attacked by the rust, regardless of their location. The most important feature connected with asparagus soil in respect to texture is its ability to supply water during periods of excessive drought, which enables the plants to resist outbreaks of rust. In some cases asparagus beds will yield $1,000 per acre.

TABLE III. — *The Mechanical Analyses of Some Asparagus Soils.*

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
1	Eastham, . . .	38.99	2.00	9.38	27.91	25.09	21.43	8.70	1.40	0.77	1.44
7	Orleans, . . .	35.28	2.20	20.97	31.03	19.70	12.26	6.26	2.77	1.46	1.37
8	Concord, . . .	49.81	4.19	4.24	10.20	12.81	27.93	34.11	1.84	1.79	1.08
32	Subsoil of No. 8, .	33.66	1.77	9.69	12.75	11.80	19.23	24.30	14.70	2.24	0.78
30	Attleborough, . .	48.76	7.54	9.26	11.15	7.87	11.53	29.57	10.95	2.52	1.42
31	Montague, . . .	33.46	2.74	0.18	2.75	14.77	23.30	44.39	6.16	1.16	3.27
33	Montague, . . .	48.71	1.86	0.27	4.39	19.86	43.88	25.75	2.64	0.36	0.14
45	Concord, . . .	42.95	12.60	6.90	12.03	10.88	21.43	15.44	6.00	5.50	2.98
46	Concord, . . .	32.82	3.20	0.73	2.69	5.69	31.73	37.84	4.48	1.30	4.30
48	Longmeadow, . .	27.34	2.80	3.52	14.88	15.90	25.48	21.60	5.46	1.21	4.31
53	South Sudbury, .	33.64	3.38	0.65	3.22	9.18	40.27	30.29	2.47	1.75	1.99
55	South Berlin, . .	29.54	2.30	5.33	17.70	10.13	11.98	14.08	23.43	4.49	3.58
73	South Deerfield, .	34.00	1.68	1.33	6.76	22.68	31.12	18.41	6.89	1.53	3.49
2	Eastham, . . .	37.13	2.60	17.93	28.80	18.85	5.80	19.15	2.85	1.34	0.66

The soil of the Connecticut valley may be described as loam, predominating in fine sand and silt, and is quite different from soils found in other parts of the State. (*Cf.* Table IV.) It is remarkably free from stones, and well adapted to the growth of onions, tobacco, pickle cucumbers and various other crops. In some parts of the valley, where the soil is mixed with coarser material, good greenhouse lettuce is grown. The most important crops, however, are onions and tobacco, and the former crop is considered better than that raised in any other part of the State. Dr. Milton Whitney, chief of the Soil Bureau, who has investigated and mapped the Connecticut valley soils, implies that they are not so well suited to the growth of the best quality of tobacco as some of the types of Connecticut soil, but they yield heavily, which enables the tobacco grower to derive considerable income from this crop.

There is an opinion prevailing among farmers that some of the Connecticut valley soils are better adapted to the growth of onions than tobacco. The greater proportion of both crops is grown on what Dr. Whitney terms "Connecticut meadow" and "Podunk fine, sandy loam;" and we cannot say whether onions require, for their best development, soil differing very materially in texture from that required for tobacco.

TABLE IV. — *The Mechanical Analyses of Some Tobacco and Onion Soils.*

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
11	Hatfield, . . .	33.33	3.78	0.05	0.13	0.30	3.38	60.35	26.29	0.71	4.34
12	Sunderland, . .	37.80	6.76	0.03	0.25	0.50	3.92	21.87	47.86	14.70	2.71
54	North Hatfield, . .	63.38	5.73	0.03	0.20	0.25	6.30	37.87	32.85	5.13	5.01
58	Sunderland, . .	32.38	4.72	0.13	3.32	0.43	5.83	52.18	23.40	2.12	1.54
59	Easthampton, . .	31.18	4.40	0.07	0.42	0.75	10.84	62.43	7.51	0.41	1.03
61	Hadley, . . .	38.78	5.32	0.05	0.28	0.33	1.08	51.46	24.01	7.75	7.00
62	Subsoil of No. 61, .	36.23	4.65	0.08	0.41	1.76	11.32	56.56	17.56	4.25	1.03
63	Double subsoil of No. 61.	34.77	2.40	0.56	0.33	4.98	2.33	50.68	18.80	11.33	6.36
70	Sunderland, . .	65.50	8.22	0.10	9.45	1.44	4.35	40.01	29.67	0.46	5.65
78	Whately, . . .	50.00	10.34	1.65	3.42	12.66	36.29	11.24	14.69	0.59	0.79
90	Whately, . . .	49.30	8.17	1.20	2.29	12.37	35.29	21.39	15.44	0.68	1.49

There is no greenhouse specialty which requires so much skill as the growing of roses, and the magnificent specimens which may be found in the markets at almost any season of the year surpass all other greenhouse products in beauty and perfection. There is no plant which requires so heavily manured a soil as the rose. The customary formula for mixing such a soil is one-third finely pulverized sod, one-third loam and one-third cow manure. In addition to this, some form of commercial fertilizer is occasionally applied. Watering the plants with a strong decoction of cow manure is frequently practised.

It is highly impracticable to use a soil of this nature for two consecutive seasons, since, owing to its high state of fertilization and the subsequent chemical changes which take place in the soil, a toxic effect is produced upon the plants. No class of greenhouse specialists is more particular about the texture of the soil employed than rose growers, especially when growing the American Beauty. American Beauties are more susceptible to differences in soil texture than other varieties of roses, and a perfectly satisfactory soil for their growth has not as yet been found in this State. They require soil of a different texture from Brides and Bridesmaids.

The rose soils in the list (*Cf.* Table V.) were obtained from various sources, some of which are noted for their production of excellent roses; while others are prospective rose soils, — that is, soils sent in by rose growers who wished to ascertain whether they were well adapted to the growth of roses. It will be noticed that most of these analyzed rather high in very fine sand and silt, while two of the samples contained nearly 10 per cent. of clay.

TABLE V. — *The Mechanical Analyses of Some Rose Soils.*

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
3	Natick, ...	43.50	9.20	4.50	6.55	6.30	13.22	32.17	5.67	1.18	9.17
29	Madison, N. J., . .	52.10	9.96	3.87	7.10	8.10	13.77	26.77	8.85	1.20	9.40
35	Clifton, N. J., . .	64.30	7.90	3.60	13.50	18.77	17.83	23.30	8.59	1.66	3.53
43	Tarrytown, N. Y., .	54.06	8.10	.19	3.00	4.58	13.69	22.88	22.25	11.25	5.94
67	Amherst, . . .	56.50	8.96	3.51	3.25	3.87	9.75	45.42	14.49	.99	3.86
79	Westborough, . .	49.20	6.06	3.21	3.13	6.92	8.80	35.81	21.14	.99	4.31
81	Subsoil of No. 79, .	34.00	3.86	5.05	3.41	7.60	13.83	38.90	19.64	.73	3.77
82	Westborough, . .	60.24	6.99	3.07	3.23	7.77	9.25	47.81	16.28	.40	1.22
80	Subsoil of No. 82, .	36.00	3.88	5.52	4.61	9.29	13.36	26.12	26.25	.87	3.87
84	Westborough, . .	42.00	8.96	4.59	4.29	9.18	13.35	22.04	26.70	1.97	2.87
85	Natick, . . .	57.90	9.10	4.76	4.00	9.61	15.08	25.57	25.55	.90	1.48
86	Subsoil of No. 85, .	33.50	3.57	7.41	6.20	14.70	18.80	25.83	9.97	11.06	1.17
88	Natick, . . .	48.00	6.02	4.73	4.19	9.80	15.74	30.00	21.75	1.41	2.59
87	Subsoil of No. 88, .	60.25	4.71	4.35	3.58	8.36	11.25	33.77	26.47	1.04	4.01

Throughout Massachusetts there are many hills of an oval shape, whose long axes run in a northerly and southerly direction. These "clay hills" are designated "drumlins" by geologists, and in some parts of the State, notably on the ridge passing through Worcester county, they are abundant and symmetrical in outline, forming the most picturesque part of the landscape.

While these are commonly termed "clay hills," their surface soil cannot be classed as such, although it is a heavy, rather cold soil, especially adapted to the growth of some of the coarser grasses, like timothy. They make excellent pastures for cattle, and many of the best dairies in the State are located in regions where these hills prevail. (*Cf.* Table VI.)

Drumlins were formerly much valued by the Indians for agricultural purposes, since historical research reveals that many of them were cleared of forest growth at the time of the first English settlement in New England. They are well supplied with water, as is shown by the fact that crops grown on them seldom suffer from drought. They are largely cleared of forest growth to-day, because they are now, as in early times, highly valued for agricultural purposes. The original growth of trees consisted of chestnut, and where forests exist on these hills at the present time they consist mainly of this species.

TABLE VI. — *The Mechanical Analyses of Some Drumlin Soils.*

Station Number.	LOCALITY.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
4	Spencer, . . .	40.70	8.50	5.32	6.80	8.88	21.96	32.51	8.07	2.02	3.05
49	Southbridge, . .	44.05	7.44	6.55	9.20	4.23	23.53	22.36	15.90	3.92	5.12
50	Subsoil of No. 49, .	33.30	3.20	5.98	8.18	6.07	15.78	16.84	19.60	13.05	6.23
51	Subsoil of No. 49, .	26.60	2.74	5.43	10.21	11.78	16.73	19.83	18.80	9.05	.39
83	East Brookfield, .	35.25	6.97	8.67	6.53	11.93	16.55	21.33	18.98	1.59	3.90

Of the remaining soils, a variety of types are represented. (*Cf.* Table VII.) A large number of these were taken from the experiment station grounds, and they predominate in very fine sand, which causes the soil to become quite compact when wet. They resemble the general type of Connecticut valley soils, and are not well adapted to the growth of greenhouse crops. The Oxford soil is from a river valley, and is suitable for truck farming. Soil No. 96 is from the Berkshire hills, and No. 56 from a Worcester county town, with an elevation of approximately 1,000 feet.

The analysis of earthworm castings is similar to that of the soil in which the earthworms live, with the exception of a small amount of organic matter.

TABLE VII. — *The Mechanical Analyses of Some Miscellaneous Soils.*

Station Number.	LOCATION.	Water-retaining Capacity.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
5	Amherst experiment station.	68.45	7.32	.95	1.05	1.72	7.29	66.19	6.96	1.33	4.13
25	Amherst experiment station.	35.40	7.00	.25	.65	.90	4.45	74.15	5.01	.65	4.05
23	Amherst experiment station.	42.50	8.60	2.80	1.80	3.05	10.70	50.95	6.70	2.35	6.50
24	Amherst subsoil, .	31.33	3.60	1.75	4.45	6.95	23.85	35.95	11.10	5.20	5.25
26	Amherst experiment station.	32.33	6.72	.35	.81	1.73	9.15	64.69	10.70	1.13	2.35
27	Amherst experiment station.	33.66	6.95	.40	.95	1.20	4.85	75.00	5.45	1.20	3.65
28	Amherst experiment station.	50.00	9.36	3.10	6.08	4.86	3.81	57.87	2.61	1.46	.73
36	Oxford, . . .	66.70	7.30	7.95	8.45	5.28	6.54	44.34	12.13	2.26	1.11
37	Amherst experiment station.	36.33	2.24	.34	4.03	5.03	6.64	74.42	1.98	.73	2.40
38	Earthworm castings.	67.76	9.60	2.10	7.51	7.45	13.40	39.26	12.13	3.21	1.79
39	Marshfield, salt marsh.	81.66	17.90	.00	.27	1.95	10.37	32.01	13.40	9.87	10.07
40	Marshfield, salt marsh.	81.33	17.50	.37	1.48	1.30	8.20	22.77	34.38	4.98	5.40
41	Wayland, fresh marsh.	142.50	77.39	.00	.30	.25	.50	2.10	.20	.45	13.05
42	Brick clay, . .	46.00	2.96	.00	.00	.00	.02	.16	15.18	15.83	64.15
56	Charlton, . .	65.13	11.10	3.07	5.62	6.41	9.28	22.51	17.97	3.84	3.57
60	Drift land, . .	25.16	.66	.13	1.08	7.85	61.06	25.82	.53	1.01	.51
64	Amherst subsoil, .	45.00	1.28	.82	2.27	2.26	13.35	29.53	14.40	14.42	12.55
66	Amherst experiment station.	59.01	9.80	.69	3.86	3.63	6.51	36.53	14.27	12.25	9.43
68	Amherst experiment station.	54.75	6.58	.99	1.48	1.53	12.51	28.02	14.51	14.11	10.41
69	Amherst experiment station.	65.25	18.21	1.45	4.40	3.85	12.93	38.13	1.50	.51	12.26
71	Amherst experiment station.	76.60	7.54	1.24	3.62	3.48	11.64	49.01	10.85	1.55	1.71
72	Amherst subsoil, .	86.10	.11	2.25	3.10	2.61	4.13	13.02	12.25	5.30	49.35
96	Franklin, . .	44.60	8.26	4.83	3.83	7.07	6.52	32.91	25.16	1.09	2.12
101	Belmont, . . .	39.33	8.42	8.90	5.59	18.64	26.19	18.48	3.40	2.60	1.63
104	Monson, . . .	37.50	8.98	3.54	2.99	9.16	17.45	19.36	27.94	2.75	3.36

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD; H. T. FERNALD.

Outline of Work.

Four main lines of work have occupied the attention of the entomological division of the station during 1906: correspondence, experimental investigations, special research and the preparation of results for publication.

The correspondence during the year has been unusually large in amount, and has extended over a much longer period than is usual. The largest amount of this work generally comes between the first of May and the end of August, but this year it began in March and continued until into December. Of course during the remaining months numerous letters are received and answered, but the bulk of the correspondence has now not only increased beyond that of previous years, but has extended over a longer period.

No unusual devastation has been reported during the past year, but all of our injurious insects seem to have been abundant, and have caused their share of loss in one line or another.

Experimental investigations have been begun or continued from previous years along a number of lines. The prevalence of the white fly in greenhouses has caused much loss, and information as to the methods of controlling this insect has been in great demand. For this purpose fumigation with hydrocyanic acid gas appears to be the most successful if made at the proper intervals of time and in the proper way; but this gas is also injurious to plants, and how much these can stand under varying conditions of light, temperature, humidity, length of exposure to the fumes, etc., has not been determined for different kinds of plants at different ages. This has accordingly been made a subject of particular investigation during the past year.

Tomatoes were the first crop tested, the usual greenhouse varieties being selected; and the plants were fumigated at all stages of growth and under varying conditions, to determine in each case the maximum amount of gas which could be used without injury. These experiments have now been completed, and demonstrate that it is possible to fumigate tomatoes with a sufficient strength of cyanide to destroy the white fly without injuring the plants, provided certain conditions are carefully observed. The information thus obtained has already been supplied to a number of persons who have had trouble with the white fly in their greenhouses, and has been used successfully, and a bulletin on the subject is now being prepared. At the present time a similar series of experiments with cucumbers, another important forcing-house crop, and one also seriously injured by the white fly, is in progress.

The prevalence of root maggots of various kinds during the past few years has called attention to the need of a more thorough study of the methods for controlling these insects; and a series of tests of these methods was begun last spring, the intention being to try different treatments recommended, and obtain evidence as to their comparative value. For various reasons, however, it was impossible to complete these experiments during the season, and it is planned to repeat them on a larger scale next year.

The last two summers have been unusually favorable for the rapid increase and distribution of the San José scale. This pest has been in Massachusetts for about fifteen years, and in the localities where it was first introduced has spread in all directions for some distance. New centers of infestation, however, have been constantly established from the planting of infested stock of one kind or another; and while five years ago most of these centers were already in existence, the number of scales at each was so small that their presence was generally unsuspected. It would seem that during the first two or three years in any locality this scale spreads but little, as the plant it is on furnishes all the food supply needed; but as these plants become thoroughly covered with the scales, the young find it more difficult to obtain their food without wandering farther from where they were born, and apparently more of them under these conditions get upon the feet of birds or larger insects which alight where they are, and are thus carried away to infest other parts. The result of this is a general infestation of the region, following four or five years after the local infestation; and it is probable that this condition of affairs was reached generally in Massachusetts about 1904. Following this were two summers extremely favorable for a rapid increase of these pests; and we now find them in great abundance in many places where their presence has not before been suspected, and quite generally scattered through the State.

Whether this explanation, which naturally is more or less theoretical, be correct or not, the fact remains that the correspondence of this station shows that the San José scale was probably present in one or more somewhat restricted areas in nearly every town in Massachusetts east of the Connecticut River in 1904; while at the present time it would probably be easy to find it in a dozen places in each of these towns, and as frequently on large, old trees as on recently set ones.

Though this insect attacks a large number of kinds of plants, those of most importance to man are the fruit trees and certain ornamental trees and shrubs; and these, accordingly, are the ones which will receive attention in the way of treatment. A number of extensive studies in the treatment of the San José scale were begun at this station in 1902, at which time the conclusion was reached that the most successful treatment was obtained by the use of the lime and sulfur mixture. Farther experiments along this line have been made as opportunities offered, and the results reached still confirm that conclusion. Last spring over eight hundred trees belonging to the college were sprayed with a number of different preparations, and a study of the results was made during the entire summer and fall. The inconvenience in making the lime and sulfur mixture, resulting from the necessity of boiling the materials for from forty minutes to an hour, has led to an attempt to avoid this by adding materials which would continue the boiling begun by the slaking of the lime for a sufficient length of time to obtain the desired chemical combinations. Several of these "self-boiling mixtures" were tested last spring, but none of them gave as good results as the lime and sulfur mixture prepared in the usual way. Perhaps the best of these "self-boiling mixtures" was that obtained by a mixture of 20 pounds of lime, 14 pounds of sulfur and 10 pounds of sal-soda in 40 gallons of water. Similar combinations, substituting sodic sulfid or caustic soda for the sal-soda, were more expensive and gave less satisfactory results.

The Derror tree fluid was also tested in the course of these experiments, but so far as could be observed failed to be of the slightest benefit in any case.

The K. L. mixture, which has been recommended by the Delaware Experiment Station, also gave unsatisfactory results, besides being quite expensive.

The Rex lime-sulfur solution was applied in four different ways, in accordance with the suggestions of the manufacturers, but none of the four gave satisfactory results, although a small proportion of the scales was killed.

Scalecide, applied at the rate of 1 gallon to 22 gallons of water, proved to be something of an insecticide, killing many of the scales; but applied with the same apparatus, by the same men and on the same day, as the ordinary lime and sulfur mixture, it failed to give anything like as good results. From reports which have been received, however, from other places, it is probable that this material, used at greater strength, in two applications and under great pressure in the pump, may prove quite effective.

Observations for determining dates of appearance of the young of the oyster-shell and scurfy scale have been continued, and the same observations have been made for the white pine scale, as upon the time when the young appear entirely depends the time at which successful treatment can be given.

The raising of cranberries in Massachusetts is a very important industry, in which a large amount of capital is invested, and the annual value of the product is over a million dollars. The cranberry plant has a number of serious insect enemies, and fifteen years ago the subject of cranberry insects was given much attention at this station, and the results obtained at that time were published. Farther study on the subject has been greatly needed, but it was impossible to make these anywhere except on the bogs themselves, and until the present year arrangements for this could not be made. Last spring, however, it was found possible to again take up the study of cranberry insects under the local conditions found on the bogs, and an investigator spent five months in continuous study of these insects on the bogs around Wareham. Many of the problems connected with the control of cranberry pests have been solved, as a result of this investigation; but many new problems have appeared in the course of the work, which make it desirable to continue the study farther, and it is the present intention to have an investigator spend six months at least during the coming year in continuing the observations begun last summer. That the results thus far have been so satisfactory is due in a great measure to the hearty co-operation in the work given by the Cape Cod Cranberry Growers' Association, and of many individuals connected therewith.

During the latter part of last winter some very remarkable cocoons found in Dorchester were sent to this division by the Gypsy Moth Commission, and were found to be the cocoons of some foreign insect. Subsequently the moths which emerged from them were identified as being native in China and Japan, and concerning which very little appears to be known. The possibility that this insect may become a pest in this country is so great that it has seemed wise to thoroughly investigate its present distribution, abundance, probable means by which it reached this country, and all that is already known of it, and this work has taken much of the time during the last two months of this year. Apparently this insect, which may for convenience be designated the Oriental moth, has been in this country for six or seven years, and it is at least possible that it was introduced on nursery stock imported from Japan. It has now spread over a considerable territory in Dorchester, where it is quite abundant. The caterpillar feeds upon the leaves of a large number of our more common fruit and shade trees. While it is yet too soon to determine whether it will become a serious pest, the experience this State has had with the gypsy and brown-tail moths has been of such a nature that it is the part of wisdom to investigate all such importations as this, and be at least prepared for the worst. The insect has already shown that it can live in our climate, that it can become quite abundant, and that it has few if any enemies. At the present time in Asia it is present over twenty degrees of latitude, corresponding to the distance from Florida to Labrador in this country. A bulletin giving all the information thus far obtainable about this insect has already been issued, and further studies of it will be made the coming year.

The other subjects outlined in this report have taken so much time that little has been done along the line of special research, only one paper having been published, though several topics are now in hand, and the work on them occupies the few odd minutes not taken by other duties.

INSECTS OF THE YEAR.

The insects which have caused much loss in Massachusetts during 1906, as indicated by the correspondence of the station and also by personal observation, have been of many kinds. The condition of this State as regards the San José scale has already been described, and the correspondence about this pest has been very great in amount. In connection with this, the oyster-shell scale, the scurfy scale, the rose scale, the white pine scale and several kinds of Lecaniums have required a considerable amount of attention. Many letters with reference to the gypsy moth and brown-tail moth have also been received, and have either been answered from here, or the writers referred to the Gypsy Moth Commission, which now has charge of the work of controlling these insects. The elm-leaf beetle is gradually becoming more abundant, and has again reached the point where its numbers are sufficient to greatly injure the appearance of our elms. During the spring months an unusual abundance of the spiny elm caterpillars was noticed, and in some places they seriously injured the appearance of the trees. Plant lice of various kinds were also much in evidence; and many specimens of tussock moths, particularly the old tussock moth, were sent to the station for identification. Many inquiries about cutworms were received, but the correspondence on this topic was less than during the two years preceding; while inquiries about wire worms and the best treatment for them were more abundant than usual. In greenhouses the white fly is a serious pest, causing the loss of thousands of dollars, and much correspondence; while thrips, which was so much in evidence a few years ago, was inquired about but twice. The asparagus root miner, an insect not hitherto reported in this State, has made its appearance in several places in sufficient abundance to cause considerable injury. But little is known of the life history of this insect, and further investigations upon it are planned for the coming season.

As a whole, the important insects this year have been of so many different kinds that it has been impossible to give to most of them the uninterrupted attention which is needed, even for our most abundant forms, in order to test the best methods of control. There is no insect known about which more information would not be of assistance in leading to the discovery of better remedies than we now have; and it is most desirable that the insects causing the most loss in any year shall be carefully studied at the time, in the hope of finding better methods of control. Such conditions as have prevailed during the past season, therefore, where work of this kind has been almost impossible on account of so many calls for information in different directions, produce a year which must be considered as more or less unsatisfactory in the way of results; and this was certainly the case in 1906.

VETERINARY DEPARTMENT.

This newly organized department of the station has been in operation since July 1 of the present year. Previous to this the veterinary work in the station has been attended to by the veterinary department of the college.

Each year for the past fifteen years there has been an increasing demand from the stock owners of the State for information concerning veterinary subjects. This demand has come to the station in the form of requests for lectures and publications, and correspondence relative to animal diseases, or to the nature of material sent for examination. The specimens that have been received have come from various parts of the State, and have consisted of diseased tissues of the larger animals, or in some instances the cadavers of the smaller farm animals; and in some cases the products of the animals, such as milk, eggs, etc. This material has been subjected to a close examination, oftentimes a microscopical study and bacteriological examination, requiring a large amount of time and labor to complete it. Living animals sent for study and examination have been kept under observation in the hospital, where experiments have been conducted to obtain definite information regarding the nature of the particular affection, as regards cause, effects, contagiousness and other closely related matters. Upon the completion of the work written reports have been sent to those from whom the specimens have come, advising them of the nature, cause, treatment or prevention of the particular affection.

On several occasions visits have been made to farms in different parts of the State, to investigate outbreaks of disease of a character peculiar either on account of the circumstances under which the disease made its appearance, the form it assumed, or the peculiarity of the symptoms accompanying its development. Experiments conducted at the station, and on the farm in conjunction with the owners of the animals, have in several instances been fruitful of most favorable results, either in arresting the progress of the disease or in preventing its recurrence.

REPORT OF THE HORTICULTURIST.

F. A. WAUGH.

Outline of Work.

The work of the department of horticulture continues on the lines laid down several years ago, and set forth in previous reports of this station. The principal experiments undertaken deal with problems in the propagation of fruit trees, in pruning, and in the systematic study of varieties of fruits. These all require a considerable number of years to secure definite results, and no report on these experiments would be justified at this early date.

Incidental to other work, a few experiments of minor importance have been underway, such as cross-grafting herbaceous plants, test of varieties of strawberries, details of certain methods in market-garden practice, some study of thermo-physiological constants, the practical application of digesting fluids in the germination of seeds, the growing of mushrooms, etc. A short report on the experiment last mentioned is appended herewith.

Notes on Mushroom Culture.

Opportunity has offered during the last two years to make several practical experiments in mushroom culture. The principal matter at issue, aside from a demonstration of methods, was the comparative value of the new pure-culture spawn. Several commercial varieties of these so-called tissue or pure-culture spawn were tested and compared, and comparison was made with the common commercial English spawn and with the French spawn. The results are summarized below.

Mushrooms were grown under the ordinary conditions. No special houses were provided. For the most part, beds were made up under greenhouse benches in a house used for bedding out stock. In one instance beds were made in an unused cellar. This work was under the direct charge of Mr. Francis Canning, head gardener.

As has been said, the usual methods were followed. For instance, in the fall of 1904 a bed was made up, November 19. This was spawned November 30 with common English spawn and with a few varieties of pure-culture spawn. The first picking was made on January 6. The entire crop from a bed of 75 square feet was something over 50 pounds. This amount was sold for an average of 35 cents a pound, bringing a total of a trifle over $17.50. This gives an average return of approximately 24 cents per square foot. Part of this crop was sold locally in quart strawberry boxes, which will hold one pound of mushrooms when heaping full. A considerable amount of the crop was shipped to Boston, selling from 40 to 50 cents a pound, yielding a net average of 33 cents a pound.

In the fall of 1905 the experiment was renewed, greater care being taken to equalize all conditions, and to give a fair test on the comparative value of varieties used. Five pure-culture varieties were included in this planting, as follows: Alaska, Columbia, Bohemia, Galloway and Agaricus arvensis (this last is the variety now called Eureka). In separate sections of the same bed the common English and the French spawns were included. The following table shows the results of this experiment. The time of first picking is indicated, and of the last picking, thus showing the length of season. The total weight is given, and dates are added to indicate at what time of the season the beds were most productive. In the last column is shown the number of pounds produced by each bed during its most productive week.

Comparison of Varieties, 1905–06.

VARIETY.	Spawned.	First Picking.	Last Picking.	Total Weight.	Square Feet of Bed Surface.	Weight per Square Foot of Surface (Pounds).	Week most Productive.	Amount for Week (Pounds).
Alaska,	Oct. 26,	Dec. 11,	March 10,	7 lbs. 4 oz.,	9	.777	Dec. 11–18,	3.375
Galloway,	Oct. 26,	Dec. 16,	Jan. 25,	3 lbs. 8 oz.,	9	.388	Dec. 23–30,	2.000
Columbia,	Oct. 26,	Dec. 16,	March 10,	6 lbs. 4 oz.,	9	.666	Dec. 29–Jan. 9,	2.500
Bohemia,	Oct. 26,	Dec. 15,	March 10,	5 lbs. 14 oz.,	9	.555	Dec. 27–Jan. 2,	2.125
Arvensis,	Oct. 26,	Dec. 15,	March 10,	13 lbs. 14 oz.,	9	1.555	Dec. 23–30,	5.500
English,	Nov. 3,	Jan. 8,	March 10,	4 lbs. 12 oz.,	18	.222	Feb. 10–17,	1.500
French,	Nov. 3,	Feb. 24,	March 10,	8 oz.,	18	.027	March 10,	.375

It will be seen that the pure-culture varieties gave much larger yields than either the English or the French spawn. While this difference is very great in this experiment, indicating probably an inferior grade of English and French spawn, all our experiments have shown a similar advantage for the pure-culture varieties. Indeed, it seems to be one of the chief advantages of the new method of growing mushroom spawn from pure culture that it nearly always gives fresher and more vigorous spawn. The product is nearly always more uniform, and of higher quality; but, while this advantage is important, it is not so great as the one already mentioned.

A comparison of the different varieties shows that Eureka (Agaricus arvensis) leads all the others in productivity, Alaska coming second. This has been the result in all the experiments in which these varieties have been tested. Eureka is darker colored than any of the other varieties, and sometimes not quite so well shaped; nevertheless, it is solid and heavy, and of fairly good quality when cooked. Galloway is a white, small, delicate variety, the best of all for eating, but not sufficiently productive to pay the grower.

The following conclusions may fairly be drawn from the experiments: —

1. Pure-culture spawn is as a rule very much better than either English or French spawn.

2. There are important points of difference between the commercial pure-culture varieties; these differences consist in color, flavor, form, and above all else in productivity.

3. The most productive variety thus far tested is Eureka. Several other varieties are promising.

As a general result of our experience, it may be said that mushrooms can often be grown profitably as a catch-crop in cellars or under greenhouse benches where conditions are favorable. The most important favorable condition to be considered is a cheap and reliable supply of fresh horse manure. It is quite plain, however, from our experience, that the stories of sudden wealth accumulating from mushroom-growing are mostly fictitious.

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